Editorial

TELEVISION begins to sound awfully close when one licence holder announces he will have a station operating within 12 months.

Whether this optimism is justified only time will tell. But already people are beginning to ask what kind of TV sets they will be able to buy.

I think it reasonable to hazard a forecast, because there are some basic points which will largely dictate design.

TV sets overseas range from about 15 to 26 valves. Our manufacturers are likely to be quality conscious, at least for a start, but they will have to prune costs. I think that 20 valves would be a fair estimate for our first sets.

As mentioned elsewhere in this issue, there are good reasons for believing that a standard size screen—probably 17in—will be accepted by all in the initial stages, again on a cost versus quality basis. Tube manufacture is an expensive and tricky business, and not until production has caught up with supply, and competition becomes irresistible, is it likely that there will be a choice of several screen sizes.

But there may be a few de-luxe sets.

Cabinets will probably resemble large, table-top receivers supported on a table or sideboard. In a home already supplied with a radiogram, another console cabinet wouldn't be popular, and only custom builders combine TV, broadcast, and radiogram facilities in a single big unit.

A loudspeaker enclosure might be used to support the TV set, thus improving reproduction. But it is probable that a smaller speaker will be included in the TV cabinet, emphasis being more on sight than sound. Psychologically there may be merit in this.

Summed up, there will probably be little difference between our first TV sets and good quality overseas products. Until such things as printed circuits cut down assembly costs, prices are bound to be high. Only big sales and mass production far outside our local demands could bring them down.

At present, selling price is not a popular subject. But if you were to buy a 20-valve radiogram, even in a small cabinet, with a costly picture tube and many hours of assembly and testing, how much would you expect to pay? Not less than £150.

But as most sets will be bought on time payment, like refrigerators and washing machines, nobody seems to be worrying about anything but the deposit.

John Moyle

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RADIO TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

The electron microscope is no longer a laboratory instrument — it finds free application in industry in various forms. An article in this issue describes such a microscope, and its application in the manufacture of paper.

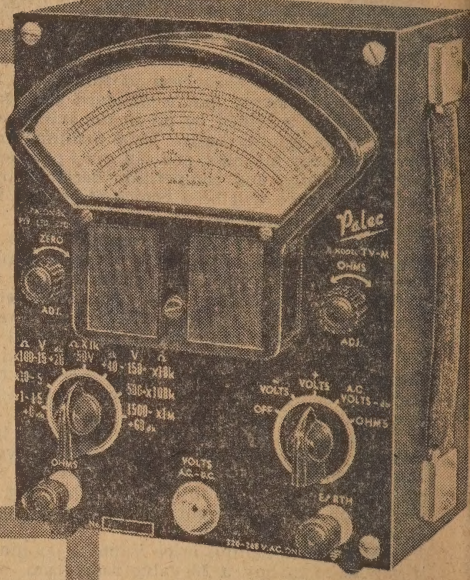
The Palec

VACUUM TUBE

VOLT-OHMMETER

MODEL TV-M

FOR SERVICE & LABORATORY



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A.C. VOLTS—R.M.S. Sine Wave. 0-1.5, 5, 15, 50, 150, 500, 1500	7
A.C. VOLTS—Peak to Peak. 0-4.2, 14, 42, 140, 420, 1400, 4200	7
RESISTANCE—(¼ of an Ohm to 1000 Megohms). 0-1000, 10,000, 100,000 Ohms—1, 10, 100, 1000 Megohms	7
DECIBELS odb= 1mW in 600 Ohms. —30/—3, —10/+17, +10/+37, +30/+57	4
DECIBELS odb= 6mW in 600 Ohms. —20/+4, 0/+24, +20/+44, +40/+64	4
Total ranges	42

FREQUENCY RESPONSE 25 cycles to 5 megacycles.. The Crystal Diode Probe extends the range to 400 megacycles.

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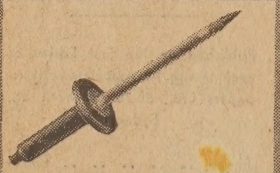
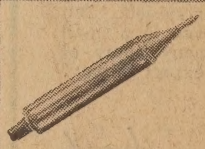


HIGH TENSION D.C. MULTIPLIER PROBE and shielded lead to extend operation of the TV-M to 30,000 volts. D.C.



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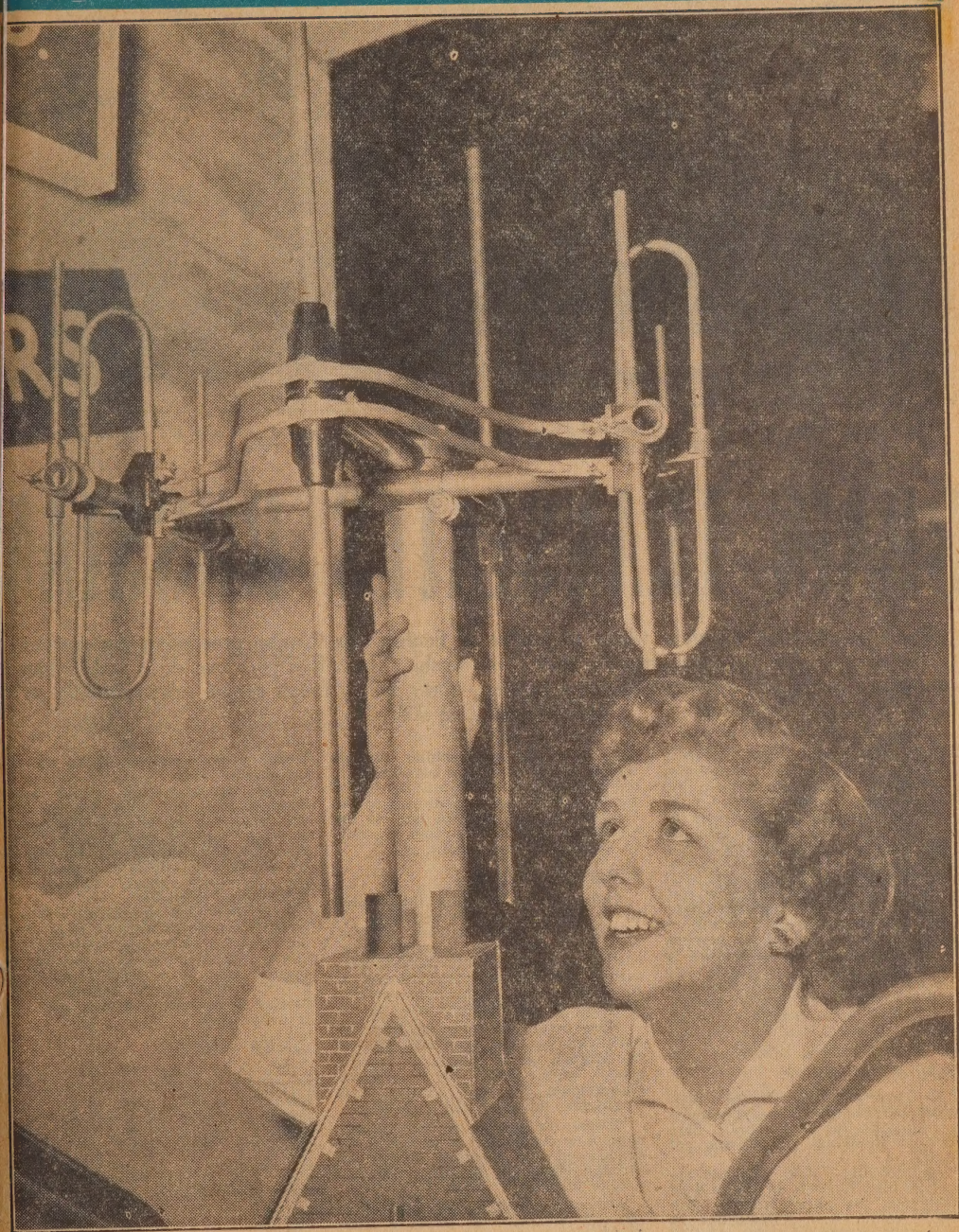


The introduction of extra channels for TV in Britain through the commencement of commercial TV services has called for a modification in aerial design. The dual type shown here will soon be more familiar on British housetops than the very simple arrays used at present. It is designed to receive both BBC programmes and those of commercial TV which will be broadcast on a higher frequency. The BBC aerial is the two-element type in the centre. Note that the polarization is vertical.

These 11 units making up the IBM can multiply and divide more than 2,000 times per second, and add and subtract more than 16,000 times per second. Maximum operations per second are 14,000.

BRAIN TRANSLATES RUSSIAN

For a machine to translate whole sentences of English into Russian preserving the correct rules of grammar, seems a fantastic feat. The machine described here can do it faster than a human being. Its operators know no Russian—they simply follow simple rules requiring no special operating skill.

BRIEF statements about politics, law, mathematics, chemistry, metallurgy, communications and military affairs were recently submitted in Russian by linguists of the Georgetown University Institute of Languages and Linguistics to the 701 computer of the International Business Machines Corporation. And the giant computer, within a few seconds, turned the sentences into easily readable English during a unique demonstration of its powers.

A girl who didn't understand a word of the language of the Soviets punched out the Russian messages on IBM cards. The "brain" dashed off its English translations on an automatic printer at a speed of two and a half lines per second.

SOME EXAMPLES

"Mi pyeryedayem mislyi posryedstvom ryechyi," the girl punched. And the 701 responded: "We transmit thoughts by means of speech."

"Vyelyichyina ugla opoyedyelyayetsya otnoshvenviyem diyini dugi k radyiusu," the punch rattled. The "brain" came back: "Magnitude of angle is determined by the relation of length of arc to radius."

A handful of men have been individually engaged in research at various institutions for almost a decade to make a machine convert the meaning of words clearly from one language to another. No practical results were achieved until Georgetown enlisted the aid of the electronic "brain" for their recently successful experiment.

POTENTIAL VALUE

This instrument was interrupted in its 16-hour-a-day schedule of solving problems in nuclear physics, rocket trajectories, weather forecasting and other mathematical wizardry, and its attention turned at brief intervals to the consideration of logic in an entirely new realm.

"The potential value of this experiment for the national interest in defence or in peace is readily seen," says Prof. Leon Dostert, Georgetown language scholar who originated the practical approach.

"Those in charge of this experiment now consider it to be definitely established that meaning conversion through electronic language translation is feasible."

Although he emphasised that it is not yet possible "to insert a Russian book at one end and come out with an English book at the other," Prof. Dostert predicted that five, perhaps three years hence, interlingual meaning conversion by electronic process may well be an accomplished fact.

The demonstration could have been carried out with English and any one of a number of languages. Russian was chosen because present-day understanding of the Soviet by Western countries is impeded by the relatively small number of students of Russian.

Scientific and technical subjects were chosen because that type of writing uses words having highly specialised meanings and it is possible to predict that if a word appears in a certain context the chances of its having a certain meaning are extremely high.

OTHER FIELDS

The same probabilities of accurate prediction occur in other fields of technical writing, such as medicine and engineering. Consequently, Prof. Dostert assumes that electronic translation will begin with separate dictionaries for each technical area, and that as experience with them grows, enough will be learned to permit accurate translation of our common everyday language, in which are such illogical and unpredictable words as "charleyhorse".

"Charley" is a nickname for Charles. "Horse" is a type of quad-

(Continued on Page 7)

HOW "COMRADE 701" OPERATES

RUSSIAN and English—or Bantu and Brooklynese—are just a bunch of numbers to IBM's "701". These numbers it records, stores and trots out again in almost infinite variety and faster than you can think of them. Below you see how it goes about translating.

First, note that it deals with whole words and that it can break up a compound word and sift out a suffix or a verb. Note also that it makes a literal translation, as you would—word for word. Then it consults its "grammar"—the rules at the bottom which read like algebra—and puts the English words into a logical sentence.

Now, if you're a puzzle fan or the type who can't resist checking on figures, follow the steps through to see how "701" thought this out.

The Sentence in Russian:

Vyelyichyina ugla opryedyelyayetsa otnoshyenyiyem dlyini dugi k radyiusu.

The Way It's Analysed:

RUSSIAN WORD	ENGLISH EQUIVALENTS I	II	1st CODE	2nd CODE	3rd CODE	RULE NO
			***	***	**	6
vyelyichyina	magnitude	———	121	***	25	2
ugl-	coal	angle	131	222	25	3
-a	of	———	***	***	**	6
opryedyelyayetsya	is determined	———	151	***	**	5
otnoshyenyi-	relation	the relation	131	***	**	3
-yem	by	———	***	***	**	6
dylin-	length	———	131	***	25	3
-i	of	———	***	***	**	6
dug-	arc	———	131	***	25	3
-i	of	———	121	***	23	2
k	to	for	***	221	**	6
radyius-	radius	———	131	***	**	3
-u	to	———				

What the Rules Mean:

RULE 1:

REARRANGEMENT

If the first code is 110, is the third code associated with the preceding complete word equal to 21? If so, reverse the order of appearance of the words in the output (i.e., a word carrying 21 should follow one carrying 110)—otherwise, retain the order.

In both cases, English equivalent I associated with 110 is adopted.

RULE 2:

CHOICE, FOLLOWING TEXT

If the first code is 121, is the second code of the following complete, subdivided or partial (root or ending) word equal to 221 or 222? If it is 221, adopt the English equivalent I of the word carrying 121. If it is 222, adopt English equivalent II.

In both cases, retain the order of appearance of the output words.

RULE 3:

CHOICE, REARRANGEMENT

If the first code is 131, is the third code of the preceding word or either portion (root or ending) of the preceding subdivided word equal to 23? If so, adopt English equivalent II of the word carrying 131 and retain the order of words in the output. If not, adopt English equivalent I and reverse the order of appearance of words in the output.

RULE 4:

CHOICE, PREVIOUS TEXT

If the first code is 141, is the second code of the preceding complete word or either portion (root or ending) of a preceding subdivided word equal to 241 or 242? If it is 241, adopt the English equivalent I of the word carrying 141. If it is 242, adopt English equivalent II.

In both cases, retain the order of appearance of words in output.

RULE 5:

CHOICE OMISSION

If the first code is 151, is the third code of the following complete word, or either portion (root or ending) of the following subdivided word equal to 25? If so, adopt English equivalent II of the word carrying 151. If not, adopt English equivalent I.

In both cases, retain the order of appearance of words in the output.

RULE 6:

SUBDIVISION

If the first code associated with a Russian dictionary word is . . . . then adopt English equivalent I of alternative English language equivalent, retaining the order of appearance of the output with respect to the previous word.

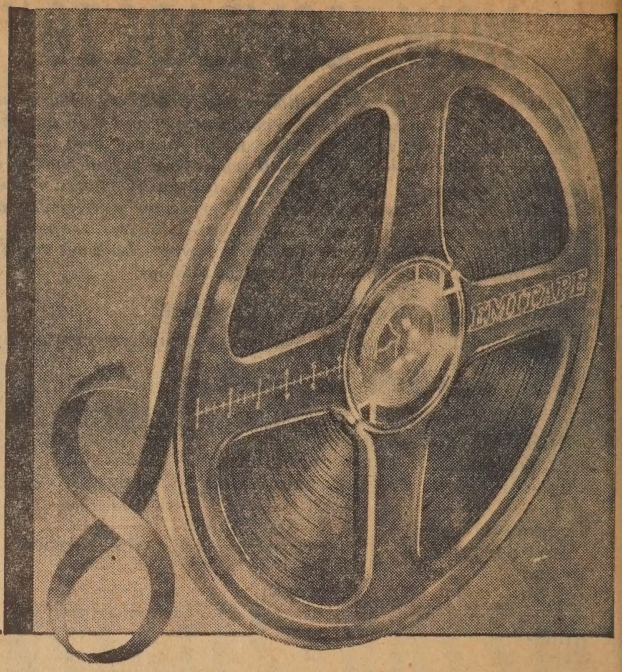
And Here's What Comes Out:

Magnitude of angle is determined by the relation of length of arc to radius.

E.M.I.

PIONEERS OF MAGNETIC RECORDING TAPE IN BRITAIN

ANNOUNCE



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STEPS IN OPERATING THE ELECTRONIC TRANSLATOR

The cards are punched with sentences in Russian.

Cards are inserted in Reading unit of 701

ped. But "charleyhorse" does not ean a horse named Charley. It eans a muscular contraction which ay take place in the calf. And alf" in this context does not mean e offspring of a cow.

What the electronic translators ave actually done is to create an ntirely new electronic language. hey have taken normal words and ttached to them tags or signs which ive each word a precision it does ot usually possess. These signs ctually denote rules of grammar nd meaning. Although only six ules were used in the demonstra- ion, the six were enough to cover ll the words in all the sentences he 701 was asked to translate.

The IBM "brain" could translate nly because these rule-tags were itched to normal words. For the brain" cannot think independent- y. It can only perform tasks in bedience to detailed instructions repared by human minds.

The six rule-tags were the solu- ion. Those particular six were hosen because they have a broader effect on language translation than any other rules. It may take as many as one hundred rule-tags to translate scientific and technical literature in general. But, no matter how large the number becomes, the six will remain basic.

The six rules govern transposition of words where required to make sense, choice of meanings where a word has more than one interpretation, omission of words that are not required for a correct translation, and insertion of words that are required to make sense.

HOW IT WORKS

Here is an explanation of the mechanics involved in the operation of one rule which governs transposition of words where such inversion is required in order to make sense.

We begin with the Russian *gyeneral mayor*. These two words must be reversed to arrive at the proper translation in English: *major general*.

The switch is assured in advance by attaching the rule sign 21 to the Russian *gyeneral* in the bilingual glossary which is stored in the machine, and by attaching the rule-sign 110 to the Russian *mayor*.

The stored instructions, along with the glossary, say, "whenever you read a rule-sign 110 in the glossary, go back and look for a rule-sign 21. If you find a 21, print the two words that follow it in reverse order."

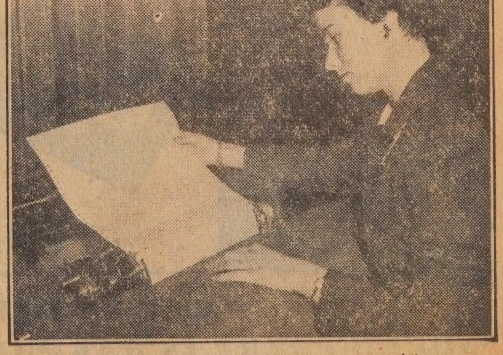
So the instant the "brain" is given *gyeneral mayor* to translate, it looks in the glossary, finds the two words there, reads the rule-sign 110, goes back and finds rule-sign 21, and automatically acts accordingly—all in the twinkle of an eye.

One more example will suffice to make the procedure clear. For it, let us take the rule governing the choice of meanings of one Russian word through the word which precedes that word in the Russian sentence.

The Russian word *nauka* means *science* in English. The Russian word *o* can mean either *about* or *of*. The proper English translation of *nauka o* is *science of*, not *science*

(Continued on Page 13)

Console operator controls cards during translation



Seconds later, English sentences come on printer

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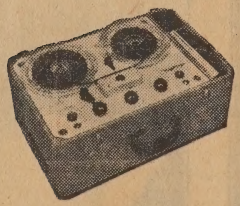

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"WHERE THERE IS HARMONY IN EVERY TRANSACTION"

...y Peter Game

Here is the RCA electron microscope similar to the one described in this article. The object is viewed by means of the screen shown in front of the operator, although a photographic record is generally used which gives better definition than that seen on the screen.

ELECTRON MICROSCOPE AT WORK

Examination of things too small to be seen by ordinary light is the special world of the electron microscope, in which beams of electrons are used to illuminate the specimen and to throw its image on a fluorescent screen. This article tells how the microscope is put to work in the laboratories of Australian Paper Manufacturers Ltd.

A WEIRD buzzing filled the room as we peered into a screen glowing an eerie green in the darkness.

An image, blurred and indefinite, moved across the screen as the operator gently moved a knob.

Suddenly the blur resolved, and we could see a picture of fine twisted articles, intertwined and tangled.

They looked exactly like pieces of tangled rope fibre; threads of appreciable bulk and weight.

But the image was deceptive.

The tiny fibres we saw were far smaller than they appeared. Far from being large and bulky, they measured only one twenty thousandth of the width of a human hair.

The machine which made it possible for us to see these minute fibres is a strange, streamlined device with an odd copper dome.

It stands about three feet high. The dome is attached to a tubular body which ends in a viewing glass.

ELECTRONIC MIRACLE

This is the electron microscope — a miracle of electronic engineering. It has revolutionised the study of the invisible world which lay hidden until the microscope was perfected about 11 years ago.

It is so sensitive that a human hair would be too big for it.

Peering into its viewing glass scientists can study the behavior of incredibly small viruses which cause illnesses such as polio, influenza and encephalitis.

The microscope even shows the strange virus known as phage, which attacks bacteria—the big boys of the germ world.

Bacteria are about a thousandth of a millimetre long, or about one five hundredth of the width of an average human hair.

The phages are only a fraction of the size of the bacteria. They are germs that live on germs. They could not be seen at all with even the most powerful light microscopes.

Before the advent of the electron microscope their existence had only been deduced. Some idea of the power of the electron microscope can be gained from the comparative magnifying properties.

A good light microscope can magnify an object about 3000 times. An electron microscope can magnify about 300,000 times.

The light microscope which was used by such renowned bacteriologists as Louis Pasteur and his wife had reached its ultimate development by the end of the 19th century.

RESOLUTION

Using ultra-violet light and quartz optics, scientists went a bit farther and in the 1920's reached a magnification of about 5000.

But here was the limit. The barrier was there and the tiny world of the virus was only a series of vague pinpoints and blurred dots.

Some of the larger viruses could be seen, but they could not be studied in detail, or, as the scientists call it, resolved.

The word resolved is important. It had been known for a long time that the ability of microscopes to reveal fine details depended mainly on the wavelength of the illuminating beam. We see things by the light waves which are reflected from them. Obviously, we will not see objects

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WHAT THE MICROSCOPE SEES

which are too small to reflect such waves.

Hence, ultra-violent light, which has a shorter wavelength than ordinary light, can bring out finer detail in smaller objects.

The shorter the wavelength, the smaller the particle which could be revealed in detail.

The smallest particle which could be shown with a light microscope is about a twenty thousandth of a millimetre, or about a ten thousandth of the width of a human hair.

This limit on the smallest particles which could be shown in detail with ordinary light set scientists puzzling.

Without getting too technical, it had been known for some time that electrons — particles smaller than an atom — if squirted off a point at high voltage, showed the same characteristics as light, or radio waves, in that they had a certain wavelength, depending on the voltage used to accelerate them.

But the wavelength in the case of the electrons was infinitely shorter, or "smaller" than either radio or light waves.

ELECTRON WAVELENGTH

Scientists worked out that the wavelength would be about 100,000 times shorter than that of light, if the electrons were accelerated by a voltage of about 60,000 volts.

It was also discovered that the beam of fast electrons could be focused by using a series of magnets instead of glass lenses as in an ordinary light microscope.

From then on it was a matter of slow painstaking development. By 1936, an electron microscope had been built which would reveal detail in particles as small as those revealed by the light microscopes.

By 1944, the electron microscope was fully developed.

As it was explained to me by Frank Crook, microbiologist at Australian Paper Manufacturers Ltd. research laboratory, who incidentally supplied the facts for this article, this is how it works.

First, the microscope consists of a tube with a heated tungsten wire at one end and the viewing screen at the other.

The wire is at a voltage of 50,000 volts. Because of this high NEGATIVE voltage, the electrons are attracted to the POSITIVE anode which is a metal ring with a tiny hole in the centre.

BEAM FORMED

The electrons hurtle through this hole and travel in an invisible beam toward the viewing screen, but on the way they are disciplined and put to work.

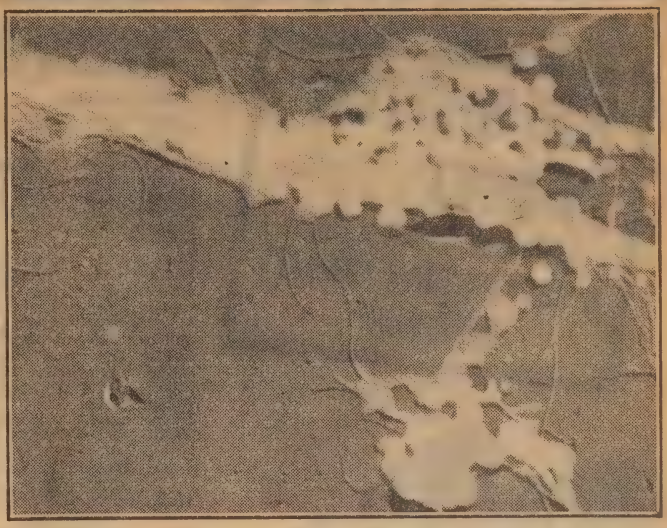
The electrons pass through a fine hole which confines them to an extremely slender beam. Then they strike the specimen which is to be studied.

The specimen is attached to a tiny grid of fine wire covered with a film of plastic.

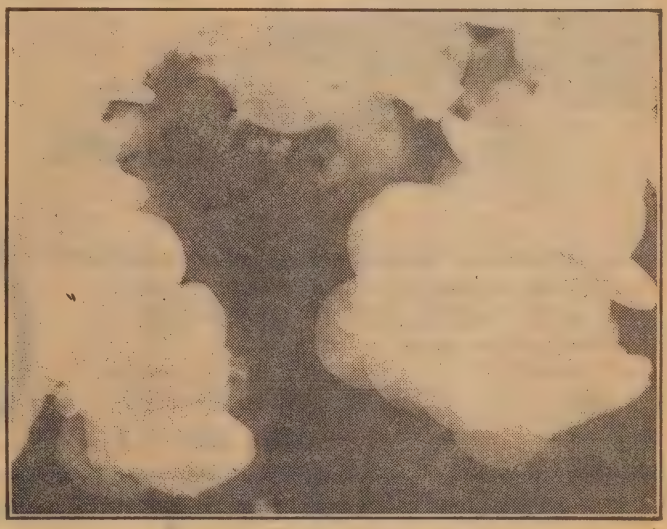
The electron beams pass *THROUGH* the specimen, then on through the magnetic lenses and on to the viewing screen.

The specimens are so tiny that an ordinary light microscope is used so that the operator can see to place them on the grid.

The viewing screen is coated with a fluorescent material, similar to that used in television tubes.



This electron micrograph shows rosin size on a paper fibre fibril. The specimen is shadowed with uranium and magnified 10,300 times.



This picture is a photograph taken through an electron microscope of cardboard made at Maryvale Mill showing the edge of the aggregate into which fines and amorphous material have been swept by the addition agent. The specimen is uranium shadowed and the magnification is 28,700 times.

As the electrons plunge through the specimen, they are slowed down according to the various thicknesses of the different parts.

This means the electrons strike the screen at different speeds, producing varying degrees of brightness on the screen's fluorescent coating. Also, the electrons leave the specimen at different angles after being "bent" on the way through.

In this way, the image is reproduced on the screen, and the specimen "seen".

Because the screen limits the amount of detail visible, the electrons are generally allowed to strike a photographic film which may be fitted to the microscope. This is then developed, enlarged, and the results studied.

The microscope has a special pump

(Continued on Page 121)

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Distortion: Of the order of 0.1 pc.
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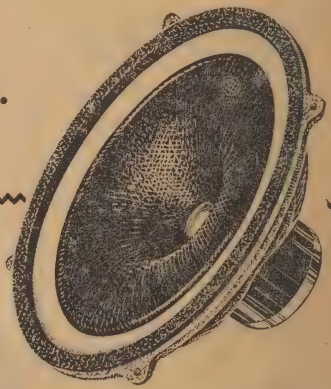

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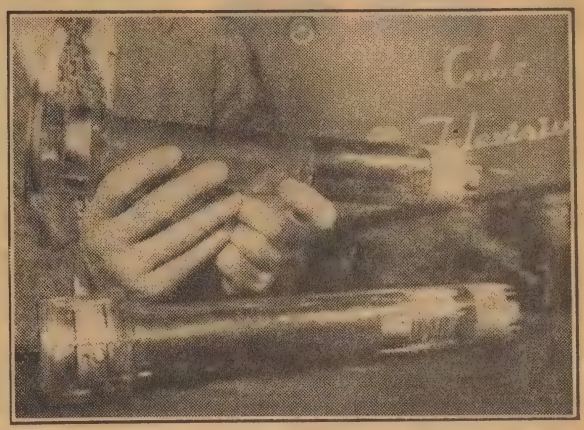
NOVEL CAMERA TUBE FOR COLOR TV

olor TV research is developing rapidly erseas, despite the almost universal use of ack and white pictures for everyday use. forts are being made to reduce the added mplexity which color requires of both trans- itters and receivers. This is particularly true TV cameras, in which considerable success has been achieved in simplification.



RCA's new experimental Tricolor Vidicon pickup tube for color TV is shown above held over a standard black and white Image Orthicon for comparison.

A REVOLUTIONARY new type of color television camera tube hat generates simultaneously the ed, green and blue signals of color V is under development and has een successfully tested by scientists nd engineers of the Radio Corpora- ion of America, it was disclosed ecently at the annual convention of he Institute of Radio Engineers.

The developmental tube, known as he Tricolor Vidicon, represents a major step in a continuing research program aimed at achieving an all-purpose color television camera as simple and compact as those now used for black-and-white TV. In tests at the David Sarnoff Research Centre of RCA, Princeton, NJ, it has shown the ability to televise color slides, color motion pictures, and scenes where high lighting may be used. Further development is expected to achieve greater sensitivity, making the tube suitable for use under varied lighting conditions.

Details of the new tube were given in a progress report by a five-man team headed by Dr. Paul K. Weimer.

It was pointed out by the group that a single camera tube capable of generating simultaneously all three of the primary colors of color TV is a major goal of television research. In present color TV cameras, they explained, a separate tube is used to pick up each color, and the three independent signals are later combined into a composite signal for broadcast.

ADVANTAGES OF THE DEVELOPMENTAL TUBE

Dr. Weimer, delivering the paper for the research team, pointed out that the developmental Tricolor Vidicon combines all of the color pickup functions for the first time in a single tube no larger than the standard Image Orthicon tube used in black and white cameras.

Since all of the color signals are generated simultaneously in the same tube, precise optical and electrical registry is ensured, thus avoiding any danger of overlapping or "fringing" of color signals. In addition, use of a single tube will permit greater simplicity and compactness in color camera design.

The research team gave this explanation of the operating principles involved in the Tricolor Vidicon:

The heart of the tube is a unique and intricate color-sensitive target applied to the face of the tube by an evaporation technique.

The target, a rectangle whose diagonal measurement is only 1½ inches, consists of nearly 900 fine vertical strips of alternating red, green and blue color filters, covered by three sets of semi-transparent conducting signal strips spaced so closely that a group of several strips would be covered by the diameter of a human hair.

The signal strips corresponding to a given color are all connected to a common output terminal, and insulated at the same time from the strips of the other two colors.

As the target is scanned by a single electron beam projected from the rear of the tube, the color-sensitive filters permit the signal strips to produce electrical signals corresponding to the arrangement of light and color in the scene before the camera.

The beam, sweeping horizontally, across the face and moving in lines that progress from top to bottom of the target—as in present camera tubes—scans the face completely 30 times each second. As the beam strikes all of the color-sensitive strips at each scanning, the tube generates directly the three simultaneous primary color signals that form the composite signal for broadcast.

BRAIN TRANSLATES RUSSIAN

(Continued from Page 7.)

about. But how can the "brain" know that?

It knows because, in its Russian-English glossary, *nauka* has affixed to it the rule-sign 242 and o carries the rule-sign 141. And the instructions in the "brain's" memory say, "whenever you read the rule-sign 141, go back and look for 241 or 242. If you find 241, select the first English translation and print both words in the order in which they appear in the Russian sentence. If you find 242, select the second English meaning." Consequently, when the computer is given *nauka* o to translate, it reads the 141, looks for and finds the 242, chooses the second meaning given for o which is *of* and prints correctly *science of.*

The first step in preparing IBM's magical computer to duplicate a human performance by a mechanical task was to write electronically, in plus and minus changes, on a magnetic drum surface, 250 Russian words and their equivalents in English. Wherever a Russian word had more than one meaning, each meaning was given a rule-sign. This set of electronic words then constituted the dictionary to which the "brain" could refer.

The second step in preparing the 701 to translate was to store the detailed instructions — exactly like those the people in Washington had followed, except that these were written in electrical charges on the faces of cathode ray tubes in the 701's electrostatic memory.

All that remained to be done after that was to give the computer the Russian words to translate. The "brain" responded at the rate of one full sentence every six or seven seconds.

Students of language are now justified in undertaking serious study of language from a mechanical point of view. They have a practical reason for trying to find out how language actually functions.

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Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 897 — 15 watts.
Prim.: 10000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

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Prim.: 10000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

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Resp.: As 931-15.
Valves: As 931-15.
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TYPE 921-15: 20 watts.
Prim.: 6600 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60000 cps.
Valves: 807, KT66, etc.
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TYPE 921-8: 20 watts.
Prim.: As for 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As for 921-15.
19% Screen Taps.

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50000 cps.
Valves: 6BW6, 6V6, KT61, etc.
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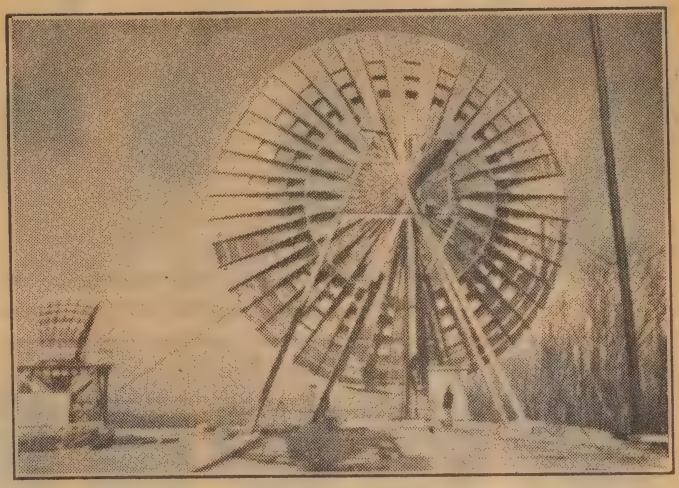
ADDING RANGE TO MICROWAVES

Establishment of radio links for TV has always presented many problems. One of the main difficulties is that, because of the necessary wide bandwidths, and our crowded ether space, microwaves must be used — and to date, the range of such transmissions is limited.

In recent years promising experiments have been made with a system which, by using high power and highly directional aerials, is able to give satisfactory transmission over paths previously thought far too long.



This antenna dish, 60ft in diameter, is intended for use with a TV micro-wave link over the sea between Florida and Cuba. The distance is 200 miles.

FUNDAMENTALLY the line-of-sight transmission characteristics of very high frequencies, beginning about 40 Mc, is a valid rule of thumb when estimating range.

But when planning radio links over hundreds of miles, this distance limitation is quite serious. It means that, if serious attenuation is to be avoided, repeater stations have to be erected every 30 miles or so.

Even with aerials situated on high ground at each end, 50 miles would be a long way.

One reason for this is that, on a long total path, deterioration of the signal over each section provides an additive degradation of a TV picture, for instance, which could become quite serious with multiple hops. Signal strength must at all times be held to a value much higher than would be needed merely to establish a contact, or which would be acceptable over a single hop.

Any means by which this line-of-sight range can be extended is therefore extremely valuable to communications engineers.

Its main value at present would be to allow long, single channel hops over paths where intermediate stations cannot physically be sited.

NEW TECHNIQUE

Of recent years a new technique has given promising results. It is quite simple, and involves merely the use of extremely high powered transmitters feeding high-gain aerial arrays to force signals beyond the horizon.

The fact that signals do travel in greatly attenuated form considerably beyond line-of-sight is not new, and has been observed experimentally for some time.

What is now being appreciated, however, is that these signals, far from being entirely sporadic in nature as they are when ionospheric or atmospheric influences are at work, are quite consistent in their appearance, although the maximum reliable field strength is only a fraction of what would be expected over short paths.

It has been found, also, that by the use of two or more aerials, normal diversity reception can be arranged. When the signal is weakest at one aerial, it generally will be stronger at one of the others. By suitable mixing circuits, the average signal strength using several aerials is generally many times greater, and is more consistent, than from a single receiving array.

Small experimental antenna used in the test. It mounts on top of this 30ft tower.

At the transmitting end, a power of 10 Kw is not excessive, and when fed to an aerial with a high power gain, could well be transformed to 100 Kw in effective radiated power.

What happens to carry the signals beyond the previously predicted path is not completely clear, but apparently there is a form of scattering which operates so that, although most of the transmitted power is lost in outer space, enough random energy reaches the receiving aerials to provide a useful signal.

Thus it may yet be cheaper and simpler to use fewer extremely high powered link stations than many lower powered types, although this could not be said at the moment.

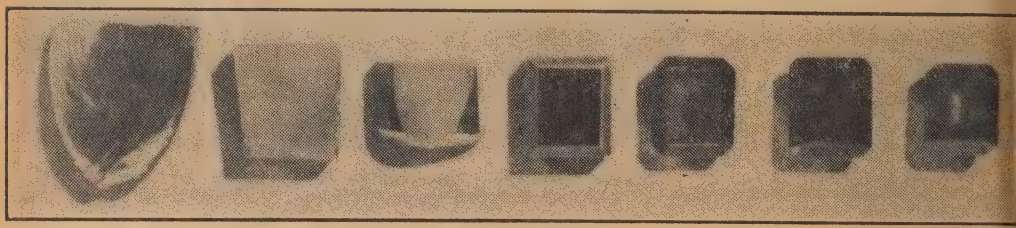
An example of this technique may be found in a radio link between the isthmus of Florida and Havana, a distance of 200 miles across the sea.

Experiments by the American Telephone and Telegraph Co. with a 500 watt transmitter on a 60ft tower has been sufficiently encouraging for the erection of a 10 Kw transmitter and a 60ft parabolic beam aerial with which it is hoped to establish a permanent link across the ocean.

Most of the early work with this technique was carried out by the Bell Telephone Laboratories on various frequencies.

Frequencies of 500 and 3700 Mc were used, with peak powers ranging up to 300 Kw, really high power stuff in any language. Their present activities are based on these tests which were initiated in 1950.

This picture shows how a synthetic ruby is built up into a boule.



From rough stone (left) to synthetic ruby (right). Seven stages in cutting and polishing.

MAN-MADE PRECIOUS STONES

Since early times man has attempted to manufacture or otherwise imitate the precious gem stones found in nature. He has had a good deal of success, as witnessed by the fact that, watches, instruments and gramophone pickups all use them. Milady wears them, too, when finances won't run to the real thing.

by Calvin Walters

LAST month we learned quite a bit about precious stones in general, with special reference to true gem stones found in the natural state.

The high price and the scarcity of natural gems has been a real incentive for man to try to make gems for himself.

The idea at first was to make something so closely resembling the natural stone that quite attractive jewellery could be made and worn in the proper places without anybody but the wearer knowing the difference.

Often enough, matters have been the other way round, with women wearing "expensive" necklaces and bracelets of imitation diamonds, when they thought they were wearing the real thing.

This, of course, has been a popular theme with writers of mystery stories for centuries. You know the plot. The Duchess has a valuable diamond necklace. Hubby goes broke, pinches the necklace, gets an imitation or "paste" set made up by an unscrupulous dealer on the Continent, swaps this over for the real thing and pawns the latter.

The Duchess goes about with the imitation round her neck, but a gang of international thieves pinches this when somebody switches off the lights at a ball, not knowing, of course, that the necklace is "phony".

When the thieves find out they organise a search for the real thing. All sorts of delicate diplomatic situations arise with poor old hubby in the background wondering how he is going to get out of it and save his face.

EVERYTHING O.K.

Everything comes out all right, of course. The thieves are all shot up in bedrooms, ballrooms, &c. Somebody lends hubby some "dough" with which he retrieves the necklace from "uncle". He plants it behind the sofa cushions and "finds" it at a convenient time. Everyone is happy and there is no war between the states of Asphaltum and Concretania. It was a near thing though!

No matter how hard man has tried to manufacture gems, there is

ways something which makes them
t quite the same as the real thing.
ney are not quite as hard or as
ear. The coloring is not perfect
id so on.

Nature, of course, has had many
ore years at her disposal than man.
ie has also had greater pressures
id knowledge of the tricks re-
uired.

Nevertheless, we have gone quite
distance, especially in the manu-
cture of synthetic stones. Some
these so closely resemble the real
ing that only experts can tell the
ifference and only then by the aid
instruments.

One wonders whether trying to
ake a diamond equal to the best
iat nature can produce, but at half
ic price, would be worth the
ouble. Who would wear it?

Would a young fellow of today
ive one to his girl for an engage-
ient? No. He would still pay fabu-
ous prices for the real thing, then
o and live with Mum and Dad
vhen he got married, because he
ouldn't raise the price of a bed-
oom suite. Such is the psychology
f the business.

VARIOUS METHODS

Various methods are used to make
imitation gems. These can be di-
vided into four main classes namely
(1) heating or dyeing natural stones;
(2) the use of glass or plastic ma-
terial; (3) joining natural stones to-
gether to make one big one; and
(4) making purely synthetic stones
having the same properties as the
natural ones.

An instance of the heating and
dyeing process can be given with the
use of the natural stone called agate.
This is a fairly hard stone, well
remembered by marble players who
have always been proud to possess
a "connie agate".

For over 100 years the Germans
have been dyeing agate to look like
something else.

For black color the agate is soaked
in a sugar solution for some weeks
and then boiled for several hours
in sulphuric acid.

If agate is soaked for some weeks
in a solution of iron nitrate then
heated in an oven for several hours
at a high temperature a red color
results.

Green colors are produced by
soaking in potassium bichromate so-
lution for weeks, then in ammon-
ium carbonate with heating—as
usual!

It will be seen that elementary
chemistry plays the main part in
these processes.

HEATING

Agate treated in this way assumes
the varying porosity of the bands
of material throughout its structure.

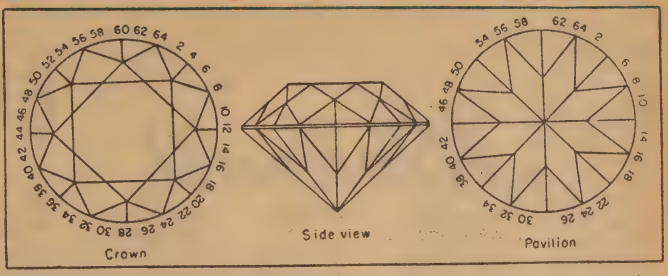
Other stones are capable of being
altered in color merely by heating
or subjecting them to x or gamma
rays.

Topazes can be turned from yellow
to a nice pink by heating.

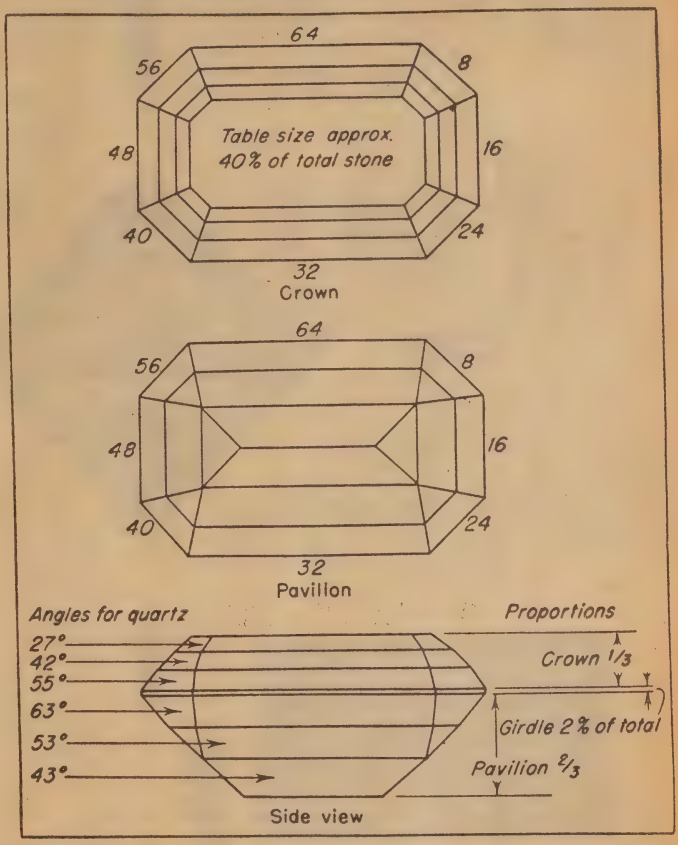
Zircons, which may be yellow
brown in color, are turned into a
very popular stone by heating, which
makes them either colorless, white,
or steel blue.

Some white or pink sapphires can
be turned a lovely amber by bom-
bardment with x-rays. Likewise a
brownish purple can be imparted

STONES CUT FOR BRILLIANCE



How standard round brilliant faceted gem stone is cut. The numbers show index positions for cutting corresponding facets when using a 64 index plate.



This shape is known as the emerald cut. The numbers indicate index positions when using a 64 index plate. Each type of cut has its own order in which the facets are ground and polished.

to white topaz, an orange to pink topaz or a light green to a blue beryl.

The first imitation gems ever made were from glass. This was colored and cut into all sorts of shapes to resemble anything.

Today one of the most popular of the imitations is the "brilliant", sometimes called a "Rhinestone".

Rhinestones proper are small pieces of rock crystal found along the river Rhine. These are cut with facets to resemble diamonds.

Today the term Rhinestone is applied to "brilliants" which are nothing more than pieces of glass cut with the facets of a diamond and backed with silver like a mirror or with tin foil.

An interesting application of a mere observation by an intelligent person is embodied in what is called a "simulated" pearl which means

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nothing less than an imitation pearl but it sounds much more toney.

In the 17th century a French beadmaker named Jacquin noticed that the water in which certain small fish were washed became full of silvery particles which finally settled to the bottom.

The observant beadmaker made a paste of this sediment with which he filled hollow glass beads, thus making a tolerable imitation of a pearl.

Later a variation of this used a fish-scale solution sprayed on the outside of solid glass beads. Cheap beads had only one coating. More expensive types received 30 or 40.

FISH SCALES

The usual process nowadays is to dip the glass into a lacquer made from the fish scales, allowing to dry, dipping again and again until the desired effect is obtained. The beads are sometimes polished individually with chamois and polishing powder.

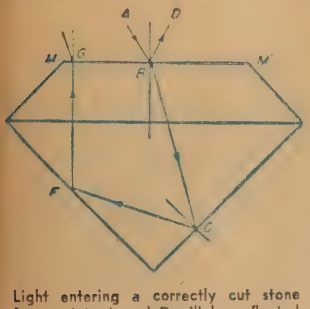
This is done between dips. It enhances the appearance considerably but is only done with the more expensive imitations.

Incidentally if you want to be sure you are not being swindled when you buy the wife pearls (so that you can stay longer at the club after the game) you can tell imitation pearls from real ones by pulling them across the teeth. Imitations are smooth to the feel while real pearls are roughish.

In the joining of stones together to make one large one, considerable skill has been attained. These are sometimes called "doublets".

There is the true doublet where two pieces of genuine stone have been cemented together and the false doublet where one piece of stone has been cemented to a backing of glass.

There are also "triplets" where a piece of glass is sandwiched between two pieces of stone.



Light entering a correctly cut stone from points A and D will be reflected from points C and F to emerge again at G. Note the change in light angle where it emerges from the crown M-MI. This is due to the difference in refractive index between the gem stone and air.

The best known of the "triplets" is what is called a "soude" emerald where two pieces of colorless quartz are cemented together with a green material. When seen from the top the stone exhibits the green color of an emerald.

If a stone is suspected of being a "doublet" it is immersed in water or mineral oil and examined with a microscope when the plane of the jointing of the materials is easily seen.

A "soude" triplet can be detected by examining the stone on the plane of the girdle when the two transparent layers become apparent.

Another method of manufacturing gems is by what is called the reconstruction process. This was discovered by Frenchmen in 1895.

They used small pieces of a valueless stone called Burma stone. These were crushed to powder. With the addition of coloring matter the powder was fused at high temperature by electrical means.

This resulted in a stone which was a very good imitation of what it was intended to represent. The stones were very popular until the advent of the synthetic stone in 1902 by a process devised by a Frenchman named Professor A. Verneuil.

By the way, it is remarkable how the French feature in this imitation and synthetic stone business.

The physical properties of synthetic stones are, to all intents and purposes, the same as the stones which they are intended to represent.

Synthetic stones are of four kinds, namely corundum such as sapphires, rubies and star rubies and other stones, spinels or Balas rubies, emeralds and rutile.

The corundum stones are used extensively in cheap jewellery and in industry for bearings in watches, meters and other types of precision instruments. The corundum ruby and sapphire provide excellent friction resisting bearings for the shafts of the delicate wheels.

All the synthetic stones with the exception of the emerald and rutile are made by the same process.

The base substance for the corundums is chemically pure alumina. This is made from chemically pure ammonium alum which is converted

(Continued on Page 118)

NOVEL STEAM-ELECTRIC IRON

This ingenious steam-electric iron for everyone is the idea of Joseph Scherner who has invented a special base for electric irons. Filled with water, it is fixed to the ordinary iron. The water heats up and, escaping as steam, dampens the article being ironed. It is called a "steam sole," and was exhibited recently at the Vienna Spring Fair.

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Technical Review

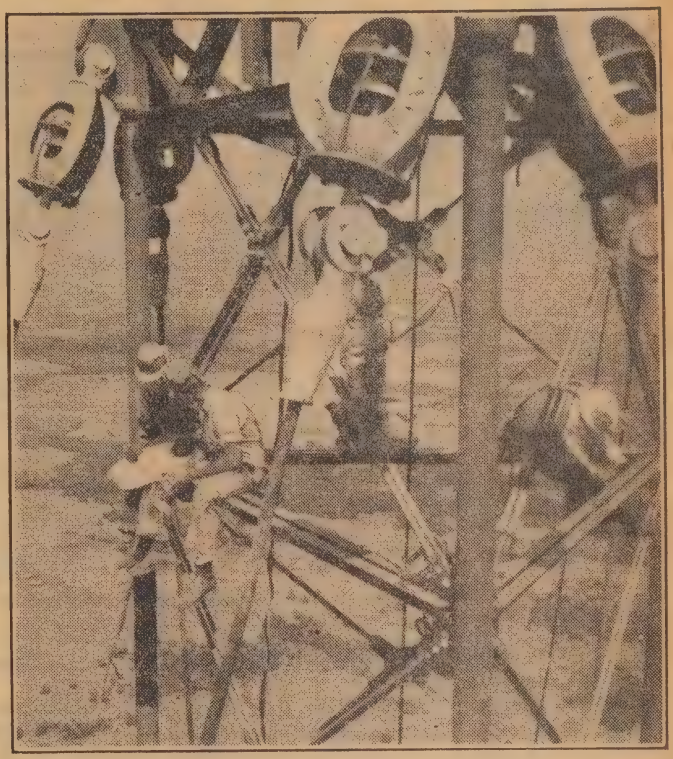
NEW TOWER IS WORLD'S HIGHEST MAN-MADE STRUCTURE

For a long time the Eiffel Tower stood unchallenged as the highest structure erected by man. Erected in 1889, its height of 990ft was not exceeded until the construction of the Empire State Building. With the completion of the TV aerial tower at Oklahoma City, USA, this record has also been broken, as this new structure is no less than 1600ft high.

THIS previously unattained height became necessary to provide the whole of the State of Oklahoma with adequate television coverage. The top of the tower is occupied by two aerial arrays, the lower one being used for normal TV broadcasting and the upper one for educational programs on a different channel.

Construction of a similar tower, 1800ft high, has begun near Montgomery, Ala., but is not yet complete.

Construction of the Oklahoma City tower occupied less than six months.



High above the surrounding terrain, two workmen nonchalantly study plans of the new Oklahoma tower. Note how the guy wires are attached to the tower structure.

Men and materials were swung aloft in this "bosun's chair". An anchor cable attached to a remote point keeps the load clear of the tower. Additional tower sections were hauled aloft the same way.

Modern engineering methods enabled the contractors to finish the structure in one-tenth of the time required for the erection of the Eiffel Tower. Its sections were assembled on the ground and then hoisted into position by "gin poles" pushed to the top of the erected sections from within the structure.

Total weight of the "mast" excluding guy wires is 600 tons. This weight is supported on a system of 21 porcelain cylinders, each 4in in diameter, and a concrete foundation. The insulated mounting should make it possible to use the mast proper as a self-radiating broadcast aerial.

Of triangular cross-section, the tower was designed to withstand wind velocities in excess of 200 mph, in order to cope with tornadoes, common enough in the central States of the US.

The TV aerials proper are attached to a supporting mast, of square section, which is fixed to the top of the tower. As yet, no technical details of the aerial system have been released, but it is to be assumed that they consist of stacked arrays designed to give coverage in all directions from the tower on both channels in the horizontal plane, and very little radiation upwards.

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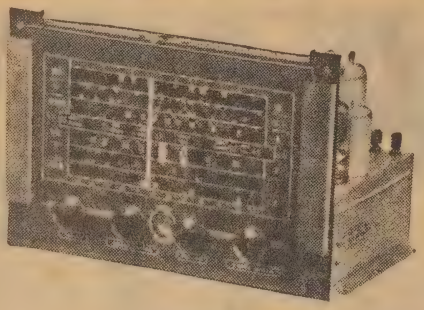

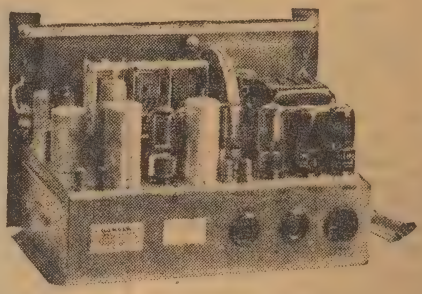

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- Power switch is fitted to the tone control of all chasses thus enabling the power to be completely switched off from the set. Radiogram switch combined with wave change switch.
- Tuning is made simple and positive even on oversea stations by the use of a super sensitive magic eye tuning indicator.
- All chasses are wired for the fitting of an F.M. or Tape Recorder. Special plug on back of chassis being provided, also standard 3-pin socket for power supply to motor.
- Speakers supplied are Magnavox 12in and 8in permanent magnet with tropic proof transformer.
- Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations in each State in prominent type, fitted with counterweight drive and indicator lights on dial showing which band in operation.
- Dial can be supplied in cream or brown with matching knobs and escutcheon to suit blond or walnut cabinets.

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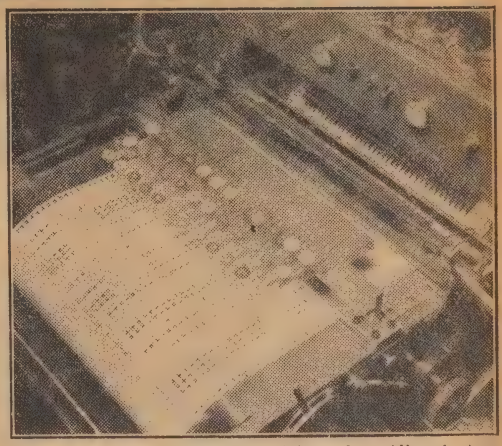
ELECTRONIC CIRCUITS NOW MAKE MUSIC TO ORDER

The production of electronic music has been taken one step further with the design of the RCA Electronic Music Synthesizer, a prototype of which has now been produced.

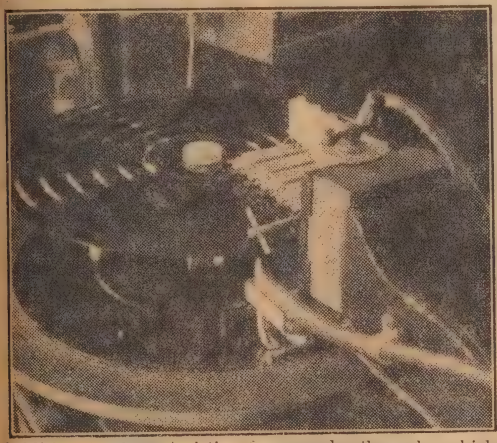
DETAILS have recently been released from the RCA of the Electronic Music Synthesizer, which has been mentioned recently in the news. This equipment was developed at the David Sarnoff Research Centre by Dr. Harry F. Olson.

The control panel of the unit is similar to that of a typewriter, with keys to control the various functions. Operation of the Synthesizer is based on the fact that all sounds can be broken down into a set of clearly defined physical characteristics, each of which can be electronically generated.

These characteristics are, frequency, or pitch; intensity, or loudness; growth to full intensity; duration at full intensity; and decay. Two additional characteristics possessed by many instruments and the human voice are portamento, or glide from one tone to the other, and vibrato.



The keyboard of the Music Synthesizer showing the punched paper record that controls the output feed to the cutting heads of the disc recorder.



The recording system of the equipment. The single tones are recorded separately on the upper disc and combined on the lower one to give a composite recording.

The Synthesizer has been equipped with circuits capable of generating each of these characteristics and combining them in any desired fashion and with any desired rhythmic pattern. Unlike conventional musical instruments, however, it has no inherent physical limitations, and it requires no physical dexterity on the part of the performer, composer or engineer.

As a result, a composer or musician, working with the Synthesizer, can create any musical effect he wishes to achieve, whether or not he is able to play an instrument.

The system is controlled by a coded paper record that is punched out by an operator at the keyboard.

The keys are arranged in five groups controlling note selection, octave selection, timbre, volume and growth, duration and decay. As the keys are touched, holes are punched in the paper tape.

The resulting code, driven mechanically at speeds up to 5 inches per second, passes beneath brushes through which the information is passed to the appropriate circuits.

The ouput of the Synthesizer is cut on to a normal record disc at a speed of 33 1-3 rpm. This turntable is coupled to the driving mechanism of the coded paper record to synchronise the two operations.

The Synthesiser is limited to production of a series of single tones, such as the tone of one wind instrument, one string of a string instrument, or one key of a keyboard instrument. This means that in simulating an orchestra or any combination of instruments, each must be synthesised separately, and the tones later combined on the recording to achieve the orchestral effect.

This method of individual recording allows the operator to work upon each instrumental effect as it is recorded until he is satisfied with the performance. It also permits the level of sound to be adjusted individually until the required total effect has been attained. Once these requirements have been met, the effect is retained on the coded paper record and may be replayed indefinitely in exactly the same form.

According to a recent article in "Audio Engineering", the author was not greatly impressed with the equipment in its present form as a musical "instrument". However, he acknowledged that it may represent a useful contribution to the composing of music, while the facilities it provides make the equipment a most creditable effort of engineering.

With continued improvements in the Synthesizer it might be possible in the future to "manufacture" recordings of synthetic orchestras and instrumental soloists, by composers and others who are unable to play the particular musical instrument in its normal form.

STATIC ELECTRICITY — MEASURED AND AVOIDED

THE production at high speed of materials possessing a high insulation resistance, such as modern plastic, has encountered a quite unexpected difficulty. Such materials, when subjected at high speed, can build up dangerous potentials of static electricity on their surface.

In plastics factories, where inflammable solvents and softeners are used, inadvertent discharge of such potentials can be dangerous and, in circumstances, disastrous, because even a small spark could cause extensive damages by fire and explosion.

The workman's safety is also endangered as the effects of discharging such potentials through the body may throw the attendant into machinery, which is normally protected from accidental touching.

Potentials up to 50,000 volts are not rare on such materials. It is, therefore vitally important that the production engineer be informed at all times about the extent of such potentials, or that these potentials be eliminated before they can build up to dangerous proportions.

A special voltmeter is now being manufactured overseas which enables the operator to keep watch over the potentials without endangering himself, and to take protective measures if the potentials exceed the safety limit.

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1 Type W Wire-Wound Controls

RESISTANCE VALUES—Available in all standard values between 5 ohms and 10,000 ohms, 2 watt rating.
WATTAGE IN ROTATION—Mechanical rotation 295°. Electrical rotation 266°.
ALL SHAFTS ARE INSULATED—Maximum operating voltage from any terminal to ground is 900 volts RMS at standard atmospheric conditions.
DIMENSIONS—Diameter, 1¾ins. Depth from mounting face, 9/16in. Shafts ¼in. dia., ⅜in. bushing. Standard shaft length, 2¼ins., from front plate to end of spindle.
TAPS—with tapping at either end of 30° or 60° of rotation or both.

2 Ganged Type Controls

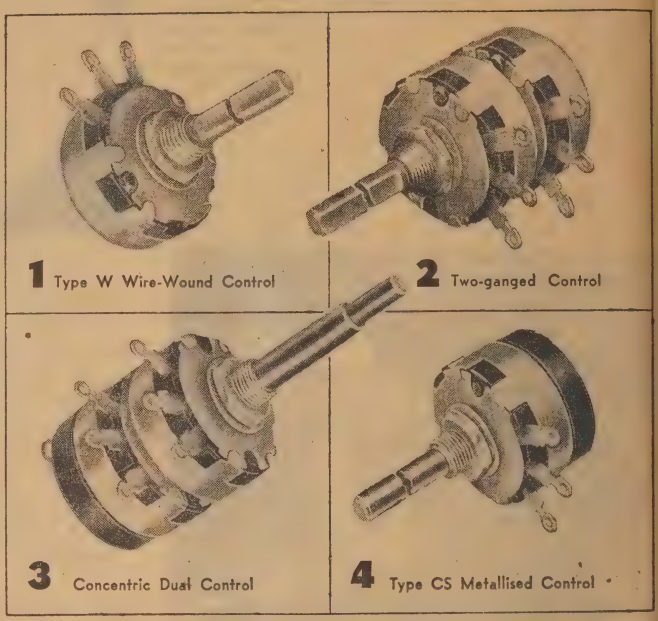
Available for a multiplicity of applications in amplifying and electronic equipment . . . in 2, 3 and 4 gang . . . in either metallised type CS or wire-wound type W. Operation from common 2¼in. shaft.
RESISTANCE VALUES
Metallised Type CS—500 ohms to 10 megs. in standard resistance values and tapers.
Wire-Wound Type W—5 ohms to 10,000 ohms in linear taper only.
NOTE: Combinations of wire-wound and metallised controls are available to meet special requirements.

3 Concentric Dual Controls

Standard IRC Plain or Tapped Volume Controls, assembled as Concentric Pairs. Supplied in combinations of Carbon/Carbon or Carbon/Wire-Wound Types with the addition of Single Pole or Double Pole Switch on rear unit if required. (The Wire-Wound Control can only be supplied on the rear unit.) Each section individually rotatable over normal rotation range.
RESISTANCE VALUES — Carbon Types: 500 to 10.0 Meg.; Wire-Wound Types: 5 to 10,000.
TAPERS—Carbon Types: Linear A or log. C. Wire Wound: Curve A (linear).
TOLERANCES—Carbon Types: ±20%; Wire Wound: ±10% Special tolerances available at extra cost.
SHAFT DETAILS — Inner Spindle, length 1⅜ins.. (controls rear unit), .187in. diameter. Outer Spindle, length 1⅜ins. (controls front unit), .265in. diameter. Flats or screwdriver slots available for quantity orders.

4 Type CS Metallised Controls

RESISTANCE VALUES—500 ohms to 10 megohms in log. or linear taper.
TOLERANCES — Standard ±20%; ±10% available at extra cost.
POWER DISSIPATION—½ watt over entire element for linear taper with power dissipation proportionate to rotation.
ROTATION—280° standard.
SHAFT—¼in. diameter, machined not die cast, standard stock lengths 2¼ins. and 3¼ins. Screw-driver slot available. **Shaft insulated.**
COVER—Cover grounded to bushing.
SWITCH—S.P.S.T. or D.P.S.T. and D.P. special for reactivation.
TAPS—One standard, also centre tap controls available in linear taper in 500,000 and 1 megohm.
TAPERS—Logarithmic and linear standard.



1 Type W Wire-Wound Control

2 Two-ganged Control

3 Concentric Dual Control

4 Type CS Metallised Control

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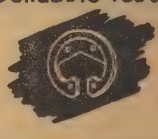
The "Silent Spiral Connector" ensures positive and permanent contact between rotor arm and centre terminal. It replaces the greatest source of noise in controls — sliding - metal - to - metal contacts.

The famous IRC multiple fingered knee action contacts are silver-plated, and each is free to glide freely and independently over the element surface.



The durable metallised type resistance element has a glass-like surface which is baked on to a moisture-proof base. The control is assembled around a moulded base to ensure rigidity and permanent absence of distortion.

These features—pioneered and perfected by IRC—ensure and maintain the utmost in performance under all conditions than any other known construction. Their quiet and smooth operation, their long life and dependable performance are established beyond doubt by trade acceptance of IRC Controls over many years. **Thus, when you specify IRC you get a control of proven performance with the quietest and smoothest operation.** Write or phone your usual supplier for full details.

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SOME RECENT DEVELOPMENTS IN TAPE RECORDERS

We reprinted from the June 1955 issue of "Radio Electronics" an article by Sol Heller describing two new developments in the tape recording field overseas. The first is a new tape drive mechanism and second a pocket-sized tape recorder for on-the-location recordings.

MECHANICAL problems in magnetic-tape reproduction have proved harder to solve than electronic ones. These problems have centred about the tape transport mechanism.

The most critical function of this assembly is to maintain constant tape speed. Speed stability is essential in avoiding distortion.

Tape cannot be made to travel at a constant speed by simply rotating the takeup reel at a constant rate. The amount of tape rolled up per revolution—and therefore the tape speed — varies with the reel diameter. This diameter is not constant; its value depends on the amount of tape on the reel.

COMPENSATION

When a reel has only a few windings, it must make several revolutions to gather the same amount of tape as a full reel does in one revolution (Fig. 1). The speed with which the tape moves will thus not be constant unless some compensation is made for the effect of the reel's changing diameter.

The conventional solution has been the use of a constant-speed shaft called a *capstan*, acting in conjunction with a mechanical *slipping* clutch. The clutch corrects for the nonuniform speed caused by the varying reel diameter.

The clutch, however, prevents an optimum torque (rotational force) from being simultaneously applied to the two reels.

In other words, if the rotational force applied to the full reel is proper, it will not be as good for the empty reel, and vice versa. This usually necessitates compromise adjustments that at best provide fair rather than perfect uniformity of tape speed.

A separate torque motor is used in more expensive machines to get around the difficulty, but here again a problem is present: the speed-torque characteristic of the takeup motor must vary in accordance with the quantity of tape on the reel.

A solution offered by International Scientific Industries is the *Isimetric Drive*. The central component of this system is a single, gear-shaped, motor-driven magnet (Fig. 2) that whirls freely within two copper-lined steel cups.

ROTATING FIELD

Each cup is coupled to one of the reels. The rotating magnetic field produced by the magnet causes the two cups to revolve in the same direction. The connection of the drive cups to the reels is such that the rotational force applied to one reel opposes the force applied to the other. The tape, as a result, is held taut between the reels.

When the magnet is centered with respect to the drive cups (Fig. 2), equal forces are applied to the cups and the reels they drive. When the magnet moves farther *into* one drive cup and correspondingly *out* of the other, the torque applied to one reel increases, while the torque for the other reel is proportionately decreased (Figs. 3, 4). The reel with the higher torque takes up tape; the reel with the decreased torque releases tape and acts as a brake.

Due to the symmetry of the system—the drive to one reel is a mirror-image of the drive to the other—a smooth transport system results. The tape reverses smoothly and easily and is capable of going from extremely slow to very high speeds with no tendency to develop slack, snap off or spill.

As previously stated, the reel which is accumulating tape should rotate slower as its effective diameter increases, to maintain a constant tape speed. This is achieved in the Isimetric Drive system, by *sensing fingers*. These fingers, due to their placement (Fig. 5), automatically move in the direction of the tape-accumulating reel.

BALANCED TORQUE

The distance they move is proportional to the amount of tape on the reel. Since these fingers are mechanically linked to the magnet shaft, they cause the magnet to move farther and farther into the drive cup of the tape-gathering reel as its effective diameter increases. At the same time the magnet moves proportionately out of the cup linked with the tape-losing reel.

The result is that the torque remains proper and correctly balanced at all times. The tape thus moves at a highly constant speed and remains under uniform tension.

A specially designed synchronous motor is used to "meter" the tape. This capstan motor, as it is called, is used only as a speed regulator—the Isimetric Drive system supplies most of the energy needed to pull the tape.

Isimetric Drive eliminates problems associated with the braking used in conventional tape recorders. Braking is necessary in all tape transport mechanisms to prevent the free-wheeling reel from spilling tape.

In conventional machines a frictional brake of some kind is commonly used, often requiring adjust-

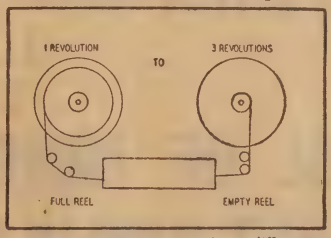

Fig. 1 Reels must travel at different speeds to maintain constant tape speed.

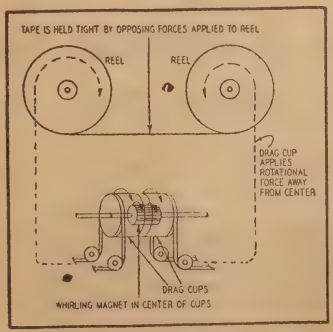
TAPE IS HELD TIGHT BY OPPOSING FORCES APPLIED TO REEL
REEL
REEL
DRAG CUP APPLIES ROTATIONAL FORCE AWAY FROM CENTER
DRAG CUPS
WHIRLING MAGNET IN CENTER OF CUPS

Fig 2 The Isimetric Drive system showing the main components of the unit.

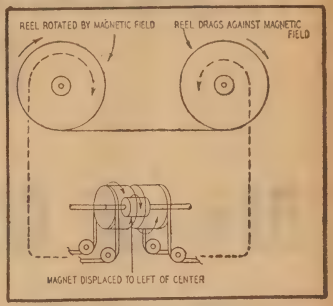

Fig. 3 Forces acting on the two reels when magnet is displaced left of center.

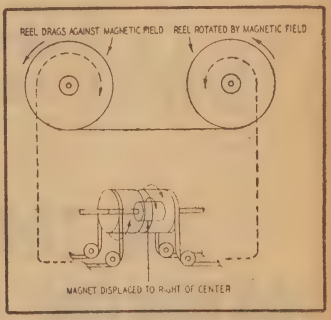

Fig. 4 Forces acting on the reels when magnet is displaced right of center.

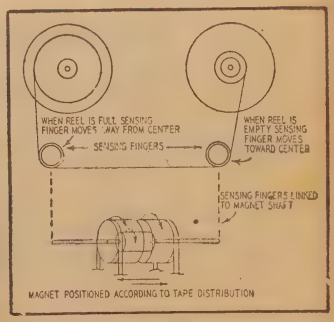
WHEN REEL IS FULL SENSING FINGER MOVES AWAY FROM CENTER
SENSING FINGERS
WHEN REEL IS EMPTY SENSING FINGER MOVES TOWARD CENTER
SENSING FINGERS LINKED TO MAGNET SHAFT
MAGNET POSITIONED ACCORDING TO TAPE DISTRIBUTION

Fig. 5 Diagram indicates the position and operation of the sensing fingers.

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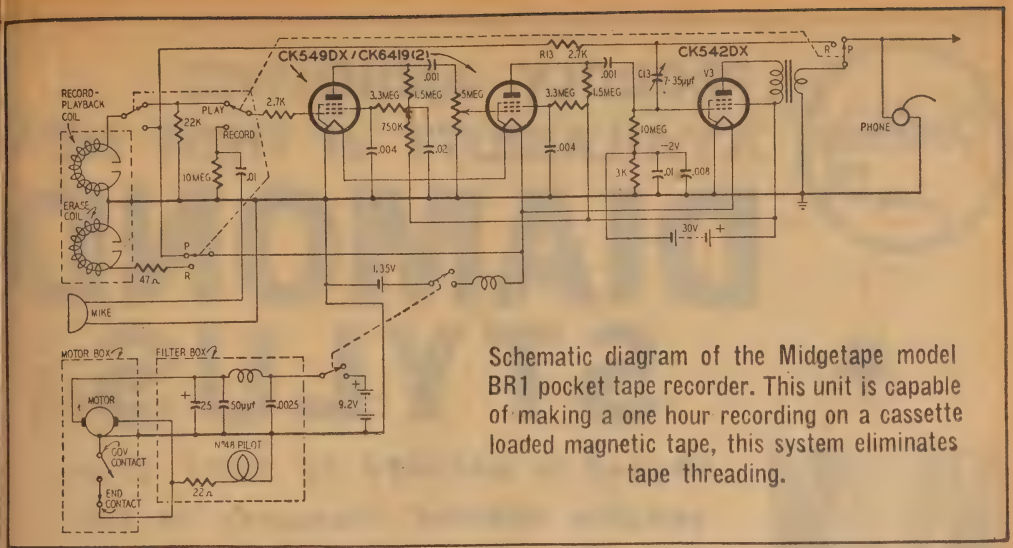


Schematic diagram of the Midgetape model BR1 pocket tape recorder. This unit is capable of making a one hour recording on a cassette loaded magnetic tape, this system eliminates tape threading.

ments for satisfactory operation. In better-grade machines using a separate torque motor for drag braking, braking may still be imperfect unless the speed-torque characteristic of the motor varies in step with the amount of tape on the reel.

Isimetric Drive provides a frictionless magnetic type of slipping clutch, eliminating adjustment problems. No adjustments are ever required for this system throughout the life of the mechanism, according to the manufacturers.

Another important problem eliminated by Isimetric Drive is the deforming of tape due to the setting up of nonuniform tensions in the tape by the tape transport mechanism.

When wide variations in wind tightness occur—a common happening with conventional machines—the tape is often stretched or temporarily deformed. This deformation is generally due to the fact that the torque affecting the takeup and supply reels (in conventional tape recorders) is different for each reel at every speed of operation. This causes different degrees of tension on the tape.

DEFORMATION

The deformation introduced becomes permanent if the tape is subsequently stored on a reel where the winding is uneven, egg-shaped or curled, since the tendency of the plastic to return to its original shape is sabotaged.

In most reels of tape, there is some uneven overlapping of successive layers of tape. Edges of the tape may overhang at certain points. If the recorder used introduces an uneven wind tightness, these edges curl, causing flap and flutter of the tape when it is going through the head units.

Much hard-to-trace flutter, wow and other distortions are due to this. In the Isimetric Drive system, the very uniform tension under which the tape is held at all times tends to prevent temporary defects from developing in the tape and keeps them from becoming permanent if they do occur.

No pressure pads are needed when tape pressure is perfectly constant. Isimetric Drive is used. Because the tape pressure against the head remains constant without any pad. Pressure pads are undesirable because they require relatively frequent adjustment and tend to introduce frictional variations that produce undesired pitch and loudness changes.

A BATTERY RECORDER

A battery-operated pocket-type tape recorder—the first such machine on the market, according to the manufacturer—is being produced by Mohawk Business Machines Corp., Brooklyn, NY.

The unit makes it possible to make inconspicuous recordings anywhere—in cars, trains, planes, etc—up to a distance of 30 feet from the source of the sound. There are smaller recording machines on the market, but these use wire as the recording material. Wire is inferior to tape in that it is weaker, as well as very much harder to handle.

MIDGETAPE, as Mohawk calls its unit is 8½ inches long, 1 7-8 inches deep and 3 7-8 inches wide. It weighs 3¼ pounds. The complete equipment includes the recording cartridge, batteries, crystal mike and earphones. Accessories include wristwatch mikes, throat mikes, shoulder holster carrying case and a two-way telephone recording adapter. The tape speed is 1 7-8 inches per second.

The recorder is cartridge-loaded—a system of loading provided in no other recorder. Only a single reel is used for the tape, with the tape wound over the reel and both its ends joined together. The tape is enclosed in a cartridge the size of a pack of cigarettes. The cartridge is simply inserted into the machine; no threading is necessary.

MIDGETAPE is capable of recording for one hour on a dual-track tape. It erases old material at the same time it makes a new recording.

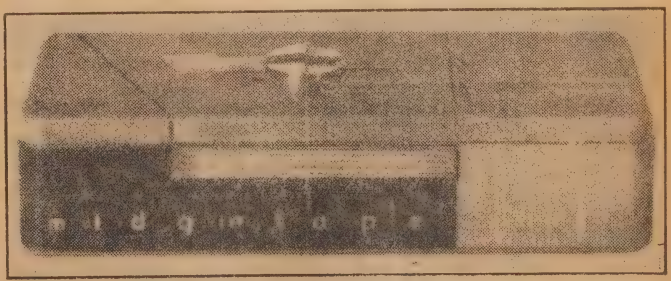
RECORDING TIME

Snap-in hearing aid type batteries are used. The motor battery life is 45 hours, according to the manufacturer; the amplifier battery is rated at 100 hours. When battery ageing has reached the point where it will permit only 2 hours more of recording, a small red light goes out, warning the operator.

MIDGETAPE has a recording time indicator that tells how much of the 1-hour recording time has been used up and how much time remains. The indicator permits the easy location of any portion of a recording for playback.

The machine is geared for swift, unobtrusive operation. Flick a switch and it starts; push the switch again, and the unit plays back. The unit has only three controls.

A manual rewind is provided to conserve battery life. Rewinding takes less than 1 minute.



The Midgetape portable tape recorder Model BR-1 which enables a full one hour recording to be made with one tape loading.

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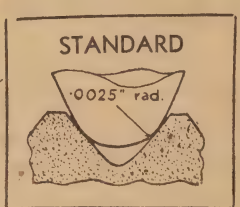

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- ★ ***NO FREQUENT STYLUS CHANGING.***
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Model or type No. .....

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Refer to Goldring Stylus Chart on the following pages for assistance in selecting the correct type of stylus

NEWS AND VIEWS OF THE MONTH

New wide-screen film

DESPITE the ballyhoo which surrounded the introduction of the wide screen technique for picture theatres, complete success has not been realised in successfully blowing up the tiny 35 millimetre films for display on huge screens.

Distortion and fuzzy projection have been the big drawbacks.

While results were good enough to get by in the initial stages, public reaction to poorer standards has led the film industry to experiment with newer methods for improving them.

Vistavision was one such method, and by reducing the effects of film grain, it was successful to a degree.

But overseas, there has recently been a move to eliminate the trouble at its source using a larger image provided by a film strip of 65 millimetres.

If the difficulties of fitting the film to theatre equipment can be overcome, the new standard might well make rapid headway, and will allow still larger screens than at present.

Mr. Freeman, the Australian managing director of Metro-Goldwyn Pty. Ltd. who recently returned from USA, said that the musical show Oklahoma had been filmed on 65 millimetre film by an independent company using MGM facilities.

The company has taken a long lease on a New York theatre, and has torn out the balcony so the full picture can be screened.

"A theatre not equipped for projecting 65-millimetre film can show the same picture from a reduced 35-millimetre version in Cinemascope," he said.

"A properly equipped theatre will be able to show a picture 60ft wide and 45ft high—twice as wide as Cinemascope allows."

More TV Stations

ACCORDING to a report from UNESCO there are now 570 television stations serving 42-million receivers in the world. This number of stations is treble the number existing in 1953.

Television stations are established in 38 countries and there are plans to introduce it to 20 other countries.

There have been significant developments in the TV field during the last two years, according to the report.

- Educational television has expanded into areas commercial television formerly covered exclusively.
- Commercial television is being established in countries where non-commercial television once held a monopoly.
- Television is becoming increasingly important in public life.
- International program exchanges are being made.

Atomic electricity

MR. STRAUSS, chairman of the Atomic Energy Commission, recently announced that electricity produced by atomic power was now being fed into the Niagara-Mohawk power system in Eastern New York State.

A prototype of the reactor for the atomic submarine Seawolf was put to work to produce steam to turn a 10,000-kilowatt turbine generator

Mr. Strauss said American companies were ready to build six commercial atomic power units with a total capacity of 765,000-kilowatts in the next five years.

Portable X-Ray

A NEW portable x-ray machine has been invented by two American Army men in which the source of power can be rejuvenated in an atomic pile.

The Medical Journal of Australia says the new x-ray might result in better radiographic facilities for remote places.

The American invention will cost about £80, weighs 48lb, and can be carried in a pack.

Power comes from a tiny piece of radio-active thulium encased in a 2in lead capsule with a shutter.

The radioactivity lasts about a year.

The thulium can then be "rejuvenated" in an atomic pile for another year's service.

Plans For TV Channels

THE Postmaster General (Mr. Anthony) has announced the frequencies for the Sydney and Melbourne TV stations. The frequencies were allocated by the Australian Control Board.

The allocation is as follows:—

National Stations.—Channel No. 2 (63/70 megacycles per second) for both Sydney and Melbourne.

Commercial Stations. — Channel No. 7 (181/188 megacycles per second) to stations Amalgamated Television Services Pty. Ltd. will operate in Sydney and a company to be formed by the Herald and

POPULAR SCIENCE QUIZ

Q.: What installations are in hand to provide a television link between England and Europe?

A.: The British Post Office is laying a new channel cable between England and France which is to be extended later this year to Germany and North Switzerland.

Q.: How are conditions within the brain analysed by electronic means?

A.: An Electro-encephalograph is used to pick up from the surface of the scalp electric signals from within the brain. The voltages are generated as chemical changes take place in the brain, due to various nerve stimuli.

From the waveforms obtained, a diagnosis can be made of the patient's condition. The major difficulty is in the complex nature of the waveforms and much research has gone in to the interpretation of these.

While the basic rhythms are clearly defined, many other patterns appear which contain not only the information required but spurious responses due to extraneous potentials, changing skin potentials, heart beats and any sounds made by the patient. Wave analysers can be used to determine the frequency and amplitude of the components.

By taking potentials from a number of points on the scalp, areas of abnormal activity can be detected and the position for surgical treatment determined. The fundamental frequencies of the adult waveforms are in the band 8-30 cycles, so that amplifiers having very good low frequency are necessary.

Q.: What materials are being used in surgery to replace damaged arteries?

Braided nylon tube has been used successfully and has the advantage over human grafts that any size and length can be made at will and can be preserved in store for any length of time. The tube has both stiffness and flexibility and will not kink. The use of this technique will enable damaged arteries to be replaced, avoiding in some cases the need to amputate a limb which was not previously obtaining sufficient circulation.

Q.: What new method is in use to speed the making of relief maps?

A.: A zinc photo engraving is first made of each contour of a normal contour map, one contour at a time. Then with the aid of a pantograph these contour layers are cut in plastic sheet. When every contour is prepared, these are assembled to make the complete relief map. A plaster cast is then made of this and the sharp edges carved away to form the actual contours. From this, many copies can be made.

Q.: For what uses have weather scientists used radioactivity?

A.: The radioactive dust particles from explosions in the Nevada testing grounds have been used to check the accuracy of predicted wind movements. To take measurements, aircraft flew through the clouds as they moved away from the scene of the explosion. Filter papers were exposed to the radiation for 30-minute intervals and the collected radiation measured on Geiger counters.

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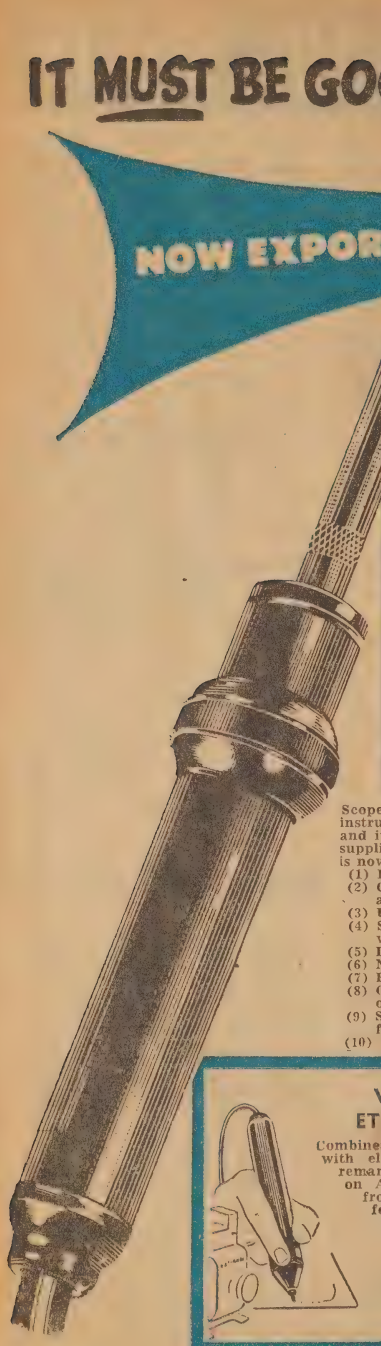

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Weekly Times Ltd. will operate in Melbourne.

Channel No. 9 (195/202 megacycles per second) to stations Television Corporation Ltd. will operate in Sydney, and General Television Corporation Pty. Ltd. will operate in Melbourne.

Consolidated Press Ltd. will form Television Corporaion Ltd.

It was also stated that the power of each of the stations would be 100 kilowatts effective radiated power.

The location for the Sydney stations would be at Gore Hill and the Melbourne stations at Mount Dandenong.

TV picture tubes

FOR months now, people have been worrying us about the kind of picture tubes to be used in local receivers. How large are they going to be? Where are we going to buy them? How much will they cost?

We haven't been able to do much more than anybody else—just guess.

Now, however, the position is becoming a good deal clearer. The majority of the picture tubes required will not be imported at all, except perhaps as bits and pieces in the initial stages. They will be produced locally and, to date, we have heard of about four manufacturers who are getting ready to make them.

There appears to be a "gentleman's agreement" to concentrate on what are commonly referred to as "17-inch" tubes. Actually, they are rectangular types with a 17in diagonal measurement and a screen measuring about 14in x 10in. They will use electromagnetic deflection and focus and carry the designation of one or another overseas type—American, British or European.

By concentrating on one particular class of tube, manufacturers hope to solve their initial production worries and cover some of their tooling costs before launching into larger tubes. They are apparently hoping to sell the 17in tubes for something under £20.

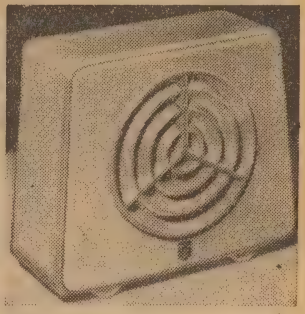
Sooner or later a swing-over to 21in tubes will come but, while it may not mean much in terms of set design, it means a good deal in tube dimensions. Manufacturers are hoping for a breathing space to get used to the smaller ones first

OUR NEXT ISSUE

Place your order now for the next issue of "Radio, Television and Hobbies". It will contain these features:

- The first instalment of a new television course, beginning with fundamentals and carrying right through to a study of television receiver design.
- Complete description of a high-powered Ultra-Linear amplifier, using push-pull type EL34 output valves.
- Full constructional details of our new sine-square audio generator, discussed elsewhere in this issue.
- More about electronic organs.
- Plus other constructional articles and all our regular features.

AEGIS FOR EXTENSION SPEAKERS



S.P.5. JUNIOR. An attractive 7in circular moulded plastic cabinet 2in deep with contrasting coloured feet and louvred front grille. Complete with 5in unit (3 ohms input imped.) LESS TRANSFORMER. Terminal block for easy connection. In Walnut and Natural only. **£2/15/0**

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Here is the amplifier, pentode version. The EF86 is nearest the camera, then the 12AX7, and behind it the two EL84's. There is no filter choke in this circuit. Controls, left to right, are—Volume, Bass, Treble and Change-over Switch from pick-up to radio.

CRYSTAL PICK-UP AMPLIFIERS

A new Playmaster design intended for crystal pick-ups which features both pentode and Ultra-linear output stages, single-chassis layout, continuously variable tone compensation, high output and low distortion. It does not completely replace Playmaster No. 6, but is to be preferred when crystal pick-ups are to be used.

THE amazing popularity of good quality amplifiers is such that valve applications engineers have been turning their attention to the production of suggested circuits, with particular stress on the selection of valve types and operating conditions for them.

In England, both Mullard and Osram, to mention only two, have evolved designs which they have publicised in considerable detail, and which have achieved great success.

In Australia, the AWA Valve Co. has been carrying out some exhaustive work on amplifiers, with emphasis on the moment on the Ultra-linear circuit and its effects on amplifier performance.

DIFFERENT ANSWERS

One of the most interesting and stimulating things about all this is that, although some very competent men have been engaged in working out these circuits, their conclusions are by no means the same.

This must not be taken to indicate that one person has all the answers, and that all other ideas are wrong. The same pattern can be found in amplifiers made and sold under commercial labels. There are many good ones, but rarely two exactly alike.

From our own point of view, we also look over these designs, and in all humility find that we have our own reactions to them. These reactions are governed primarily by our own particular function of interpreting and providing for our readers what we think is the best course for them to take, bearing in mind that they will have to use components which can be bought over the counter, and assemble them without the benefit of special test equipment.

Apart from actual circuitry, these amplifier designs, which originate from valve specialists are particularly valuable in that they give with considerable accuracy vital information on how valves should be used.

Their advice in this matter is really an extension of the valve characteristics themselves, to which all users must refer when deciding how they can best be incorporated in equipment.

It was only natural, therefore, when considering a new layout for a special amplifier for crystal pick-ups, that the Mullard circuit should catch our eye.

Not only did it contain much interesting information about the use of the new EL84 output valve, but it also solved very neatly the problem of variable tone controls for use with crystal pick-ups.

It also included an equally neat amplifier-phase-changer combination using a direct-coupled circuit which looked most promising.

These features were eventually incorporated in the amplifiers to be described in this article.

In general form, however, the amplifiers have been laid out to conform to the Playmaster technique, and the design carried forward to include an ultra-linear output stage.

The desire for a "crystal" amplifier of new design was largely inspired by the release of the EL84, and the possibility of using it to push the output up to the higher level we generally expect from a pair of beam power valves.

It will also answer in one swoop all those readers who have written asking about larger valves in the existing No. 6 circuit which, with its 6BV7's, supplied about eight watts.

We felt, too, that here was a circuit which could be used successfully in a number of ways with no major changes.

Firstly, if no tuning unit is required, it can be built purely as an amplifier, with a power supply giving between 250 and 300 volts, and a low rating power transformer.

A heavier power transformer is all that is necessary to convert to a radiogram with one of the standard Playmaster tuners.

Finally, if you want to go for the best, an ultra-linear output stage is the logical answer, with the addition of a filter choke to give the best possible filtering.

This version is capable of extremely high performance, limited only by the quality of the output transformer.

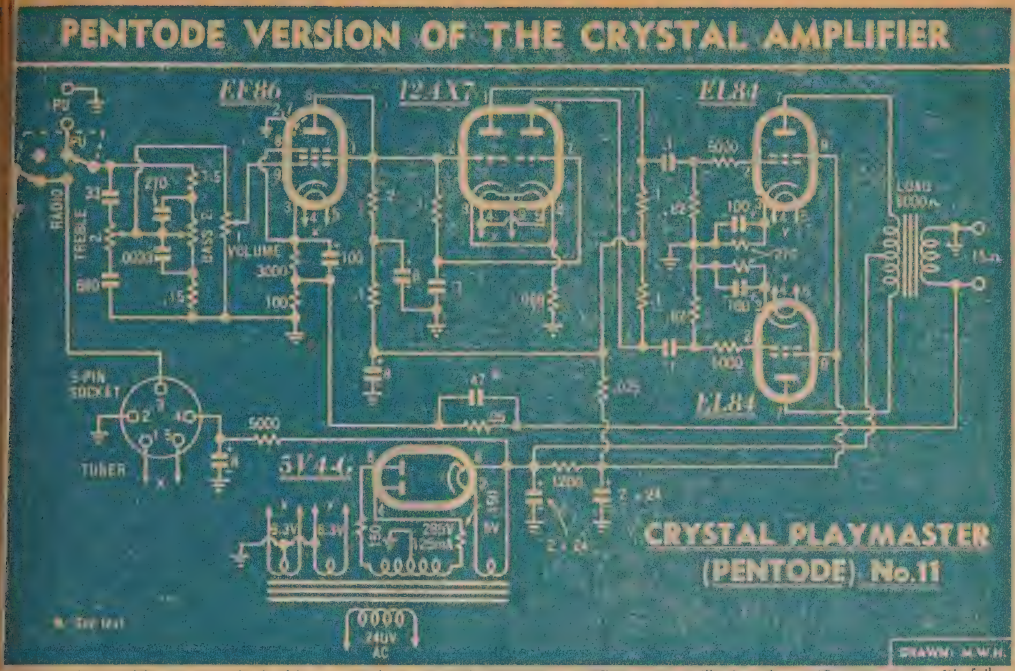
PICKUP DIFFICULTIES

In the past, we have published a number of articles about standard crystal pick-ups, and how to use compensation with them to flatten out the response. The crystal pick-up is quite the most popular for general use, but unfortunatelyy design makes it almost impossible to avoid peaks and bumps in the output, with the possible exception of some special types.

If trouble is taken to hand-tailor suitable circuits, things can be improved, but our experience has been that there is no single method of

by John Moyle

PENTODE VERSION OF THE CRYSTAL AMPLIFIER



This is the amplifier circuit wired with a pentode connected output stage. This version will give almost 17-watt output with full plate voltage. The filter choke may be omitted and the power supply wired as shown above. The phase correction capacitor marked with an asterisk was chosen for the transformer used, but this value should be OK for almost any other type.

compensation which can be used successfully with all types.

The best idea seems to be to buy the highest quality pick-up you can afford, and to use it with an amplifier having a wide range of bass and treble adjustments, which can be set until the music sounds best.

This isn't an acceptable idea to the seeker after the highest fidelity, but this amplifier, although its response as such is extremely good, isn't designed for these people.

It is intended primarily to give you, on one chassis, something which will work from practically any type crystal pickup and sound well.

The man who is interested in this kind of amplifier seems to prefer continuously variable tone compensation controls to the stepped type.

If these controls are to be used to supply all the compensation, there is much virtue in the idea. It allows the utmost flexibility, whereas a stepped control would probably limit the range of adjustment far too much.

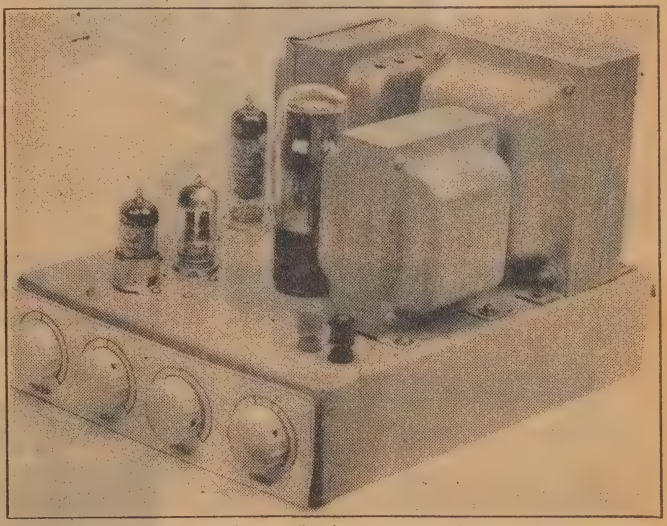
RANGE OF CONTROL

This amplifier has quite a wide range of control. The treble cut is quite severe in the maximum condition, but LP records frequently call for this because of their initial pre-emphasis.

The bass response of a crystal generally has a rising characteristic, which helps to compensate for the bass cut in the recording. Consequently special networks designed to level the response are not generally recommended with the amplifier. Best results seem to be obtained by running into a load somewhere between .25 to 1 meg, wired across the pick-up terminals, and then using the controls to do the rest.

The input sensitivity for full output is about .45 volts with the pentode connection, and about .7 volts for ultra-linear. As full output will be between 13 and 17 watts, this means that even pick-ups with moderate output will give all the volume you can stand.

The sensitivity is ultimately determined by the amount of feedback. Both circuits are set for about 15 db of feedback. A little more or



Here is the amplifier wired for an Ultra-linear circuit and with a standard power supply using a filter choke. Make sure that the cores of the power and output transformers are at right angles to their centres. Controls, etc. are the same as for the pentode version.

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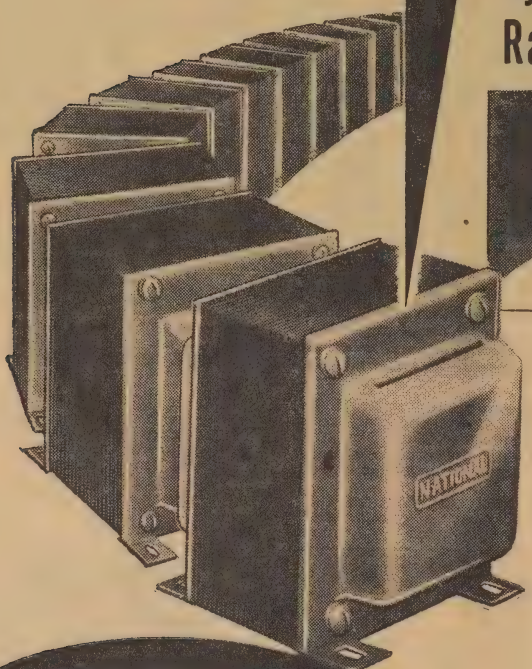

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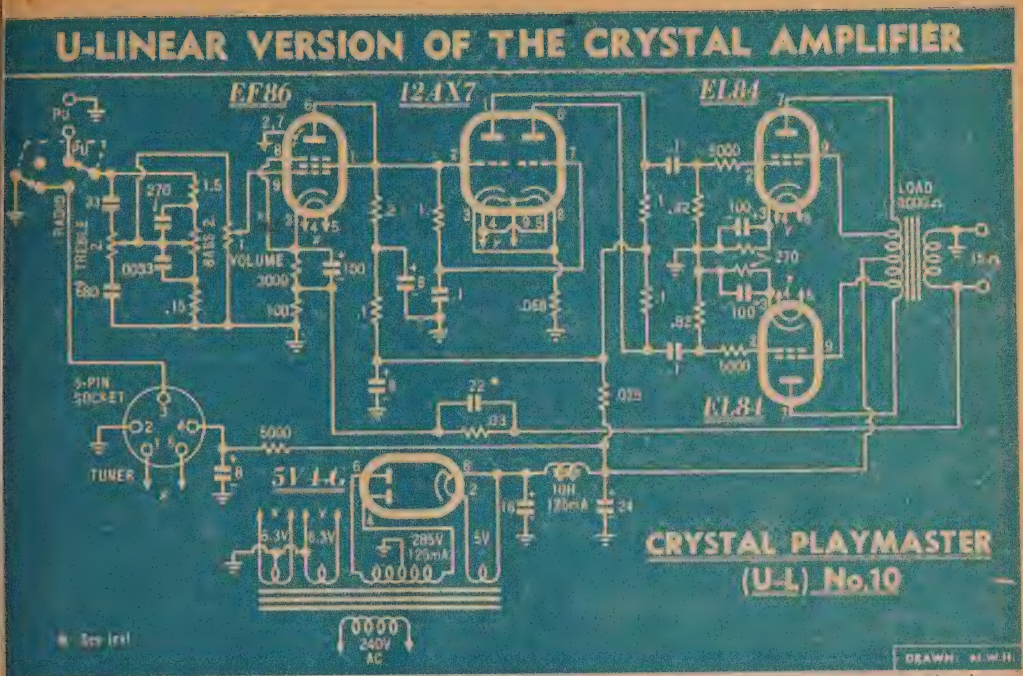

The Ultra-linear circuit is similar to the pentode version except for the output stage and power supply. Once again the phase correction condenser was chosen for the transformer used. Limiting resistors in the high-tension leads are not necessary.

less would give a corresponding variation in sensitivity.

Note that feedback is placed right around the amplifier, from the output transformer secondary to the cathode of the first amplifier. In the No. 6 Playmaster it will be remembered that this valve was not included in the feedback loop.

The range of compensation is from 10db of treble boost to 10 db of treble cut, and from 11 db of bass boost to 5 db of bass cut. The "flat" position will occur somewhere near the centre position of each control, but there is some interlocking between them which is difficult to avoid with this type of circuit.

The compensation circuit is placed immediately after the pickup and has a gain reduction of about 12 times. This means that the amplifier itself has an actual sensitivity of around 50 millivolts or less, which, associated with high impedance circuits, is very prone to pick up hum.

INPUT SHIELDING

To avoid this, the controls are grouped along the front edge of the chassis, and a right-angled shield, not shown in the pictures, is provided to completely box in these controls and their associated wiring, as well as the first valve socket and all its associated components.

The filament, power, and output leads to this part of the circuit run through small grooves cut into the edge of the shield, which is held to the chassis by three turnover feet bolted to the underside of the chassis top, and by two small brackets bolted or soldered to the two front corners.

This shielding is effective in completely avoiding any stray pick-up.

The input to the amplifier is via a switch, which allows input either from the pick-up terminals or from the 5-pin socket which connects to the tuner. A shielded lead runs from the switch to the socket. Note that a second switch section short-circuits the input from the tuner to prevent "play-through" when using the pick-up.

Incidentally, the voltage divider usually employed in the Playmaster tuners to reduce output need not be so severe in its reduction of voltage. Experiment will be best, but we suggest using resistors of equal value to reduce the available output by one-half.

Construction of the front section is made easy by the earth wire which runs along in front of the potentiometers and connects to the earthed pickup terminal. All components associated with the front end are earthed to this wire, which in turn is connected to the chassis at one point near the 12AX7.

The idea is to provide a single earthing point for this part of the circuit, thus avoiding any possible

PARTS LIST

PENTODE VERSION

1 chassis, 10 x 8½ x 2½in.
1 shield 5⅛ x 8⅝in. (See article)
1 power transformer 285V/125 mA. (See article).
1 Output transformer 8000 ohms P-P to suit speaker. (See article)
3 Noval sockets (ST29G, mica filled.)
1 Noval socket with skirt (Ceramic or mica filled.)
1 Octal socket.
1 5-pin socket.
1 min 4-pin speaker socket and plug.
5 valves, EF86, 12AX7, 2 x EL84, 5Y4.

CAPACITORS

4 24 mfd 525 V electros, 3 8 mfd 525 V electros, 2 100 mfd 40 V electros, 1 100 mfd 12 V electro, 3 .1 mfd 400 V paper, 1 .0033 mfd mica. 1 680 pf mica, 1 270 pf mica. 1 47 pf ceramic 1 33 pf ceramic.

RESISTORS

2 2 meg potentiometers, 1 1 meg potentiometer, 1 1.5 meg, 1 1. meg, 2 .82 meg, 1 .2 meg, 2 .1 meg 5%, 1 .1 meg, 1 1.5 meg, 1 .068 meg, 1 .033 meg, 1 .03 meg 2 5000 ohms 1 3000 ohms 1 100 ohms. (All ½watt.) 2 270 ohms 3 W. 1 5000 ohm 3 W. 1 1200 ohm 1 W.

SUNDRIES

2 8 point tag strips 1 2 pole 2-pos. Oak switch. 3 3 point tag strip, 4 knobs, nuts, bolts, solder lugs hook-up wire, tinned copper wire, 2 terminals, power, flex and plug.

ULTRA-LINEAR VERSION

In the ultra-linear version the high voltage electrolytics needed are: 1 24 mfd 525 V, 1 16 mfd 525 V and 3 8 mfd 525 V, which replace those shown in the pentode list. The output transformer should be an 8000 ohm plate to plate U/L type, to suit the speaker used. An additional item required is a 10 Hy 125 mA choke.

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DESK or HAND MICROPHONE

MIC 36

Housed in attractive plastic case, this Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni- directional frequency response substantially flat from 30 to 7000 c.p.s. Recommended load resistance not less than 1 megohm dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor as required at a small extra cost.

£6/18/6

HIGH QUALITY MICROPHONE

MIC 16

Designed to meet even the most exacting requirements, this Microphone incorporates the world famous floating crystal sound cell construction. Its special characteristics are that its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise.

SPECIFICATION

Recommended load resistance—not less than 1 megohm.
Output level —65 db ref. 1 volt/dyne/cm².
Frequency response—substantially flat from 30 c.p.s. to 10,000 c.p.s.
Directivity—non-directional.
Size—2-1/8in spherical diameter.
Connector—Standard international 3-pin.

£24/19/6

GENERAL PURPOSE

MIC 35

The MIC 35, undoubtedly the best value ever offered, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5000 c.p.s.

£2/15/-

SPECIFICATION

Output level: —55 db ref. 1 volt/dyne/cm².
Cable—approx. 4ft. of co-axial supplied.
Weight—6ozs. unpacked, 7 ozs. packed.
Dimensions—microphone only 2¼in x 2¼in x ⅞in.

TABLE or STAND MICROPHONE

MIC 22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the quotation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost.

SPECIFICATION

Output level = —50 db ref. 1 volt/dyne/cm².
Output impedance—equivalent to approximately 0.002 uF (0.8 megohm at 100 cycles).
Frequency response—substantially flat from 40 to 6000 c.p.s.
Recommended load resistance—not less than 1 megohm, dependent on low frequency response.

£9/18/6

LAPEL MICROPHONE

MIC 28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

Output level—approx. —55 db ref, 1 volt/dyne/cm².
Recommended load resistance—5 megohms.
Frequency response—level throughout the whole of the audible spectrum.
Capacity—0.0015 uF. at 1000 c.p.s.
Impedance—100,000 ohms at 1000 c.p.s.
Cord—6ft. shielded cable.
Size—1-9/16in wide x 2¼in long x 5/8in thick.

£5/19/6

HAND or DESK MICROPHONE

MIC 33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7000 c.p.s.

£6/18/6

CRYSTAL MICROPHONE INSERTS

MICROPHONE INSERTS

(MIC 32 illustrated)

These inserts are available in varying sizes ranging from as small as 15/16in square to 1-13/16in round, with various thicknesses from 7/32in to 9/16in. Suitable for every purpose such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2250 c.p.s. to 3500 c.p.s. at 5 db to 30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC 19/4 and MIC 32, £2/15/6; all other, £1/19/6.

MICROPHONE INSERTS

(MIC 23 illustrated)

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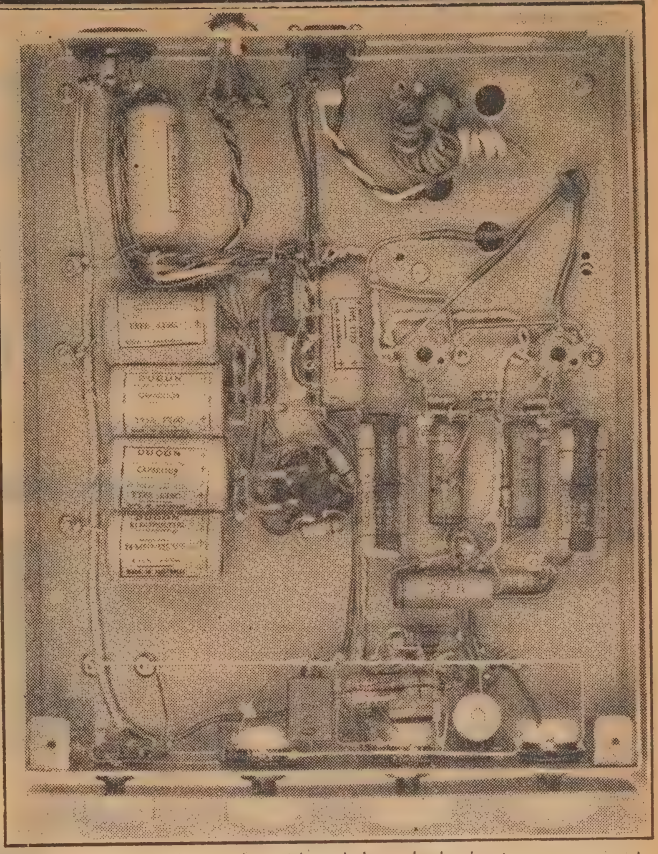
UNDER-CHASSIS OF AMPLIFIER



This picture is referred to in the article and shows clearly almost every component. It is the pentode amplifier—the U-L version has only two main filter condensers, shown at the left. Note the corner brackets which help to mount the shield over the front end. Symmetrical layout has been aimed at.

irth loops which might occur, with sulting hum pickup, if earth oints are indiscriminately made. This technique is only important the first stage where the gain is ghest.

The EF86 plate and screen resist-s, cathode resistors, and conden-rs may be supported on a couple 3-tag terminal strips bolted to ie chassis near the EF86 valve ocket. There is plenty of room to them in under the shield.

The EF86 is triode-connected and irect-coupled to the cathode-oupled phase-changer, which we ave used in several of the latest ircuits.

The original Mullard amplifier used pentode connection in order to btain higher gain to support a large mount of feedback. But experi-nce has shown us that high feed-ack generally means individual ad-ustment and careful phase correc-ion if instability is avoided—a big rice for the home constructor to ay for slightly reduced distortion.

The triode connection gives lower ain, but the use of less feedback rings the total sensitivity up to bout the same figure.

The EF86 bias is adjusted to give bout the same plate current as vith pentode connection, so that the alues for the direct-coupled circuit nay remain almost unaltered.

The main objection to direct oupling is that, if either valve hould vary in emission, circuit con-ditions may be upset. However here is a certain amount of auto-natic compensation which reduces his risk to a reasonable level.

Absence of a coupling condenser reduces the phase shift in this por-tion of the amplifier, and adds to stability.

AMPLIFIER IS STABLE

In practice we found it impos-sible to make the circuit oscillate, even with feedback well over 20 db and with grossly incorrect phase correction values across the feed-back resistor.

This inherent stability is a valu-able feature where a wide choice of output transformers is involved.

The phase-inverter and output stage are laid out to provide exact symmetry in the push-pull connec-tion. The two plate connections for the 12AX7 have their axis parallel with the front edge of the chassis so that the coupling condensers fall naturally into place. A terminal strip placed just ahead of the out-put sockets carry the grid resistors and suppressors, and also anchor the cathode resistors and condensers. A glance at the underchassis photo-graph will tell you all you need to know to put you on the right track.

We have not used screen sup-pressors because at no time were they found necessary. Even the grid suppressors are there merely as a precaution.

The output bias resistors may need to be 250 and 20 ohms in series if the odd value is hard to get.

The output transformer must be mounted with its core exactly at right angles to that of the power transformer to avoid mutual coup-ling. If this is done there will be no hum pickup despite their proximity.

If you are very fussy you can pick the exact position by test in a manner described several times in past issues, removing the rectifier but leaving the mains connected to the power transformer.

For the pentode version a straight output transformer of 8000 ohms output impedance is used. It must be of reasonably good quality which rules out the PA type. Several good multi-section transformers are ob-tainable, and it is good practice to buy the best you can afford.

NO FILTER CHOKE

With the pentode connection it is possible to eliminate the filter choke to save on cost, using instead a resistance capacity filter for the out-put screens and the remainder of the circuit, and feeding the plates directly from the rectifier. With beam power valves and pentodes, having a high plate resistance, this is quite satisfactory.

It calls for extra filter conden-sers which offset the saving of a choke, but of course you can use a choke in the normal way if you have one.

We have included this type of resistance-capacity filter in the pen-tode circuit to illustrate the point.

Note the small 1-watt resistors connected in series with the high voltage leads to the transformer. These limit the peak current de-manded from the rectifier by the high first capacitor value, and avoid damaging it. The exact value should be calculated after measuring the resistance of the windings, but the value given should be adequate in most cases. The underchassis pic-ture was taken with this circuit.

The filter condensers are support-ed at the "hot" end with a resistor strip, which also supports a decoup-ling condenser and the dropping re-sistor for the tuner.

There is plenty of room to sup-port these odd components in al-most any manner you choose, but we have shown you our amplifier as a guide.

In the ultra-linear circuit, the screens cannot easily be isolated from the plate circuit, and we strongly advise the use of a filter choke and a normal connection as shown. The first filter condenser should not be higher than 16 mfds with this circuit.

In all cases, a 285 volt transformer will supply about 300 volts between

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The need for a well designed, low cost, high quality amplifier is reflected by the already unprecedented wide acceptance of the Mullard 5-10 amplifier. The popularity of the design, both in England and America, has resulted in the amplifier being now available in many kits forms—even a printed circuit version.

A brief specification of the amplifier is as follows:—

Power Output: Rated output 10W. Max. output 12-13W.

Total Harmonic Distortion: The total harmonic distortion is less than 0.4% at 40 c/s measured for 10W. output with normal loading and sine wave input.

Hum and Noise: —73db relative to 10W.

Frequency Response: ±0.5ab, 10 c/s to 20,000 c/s.

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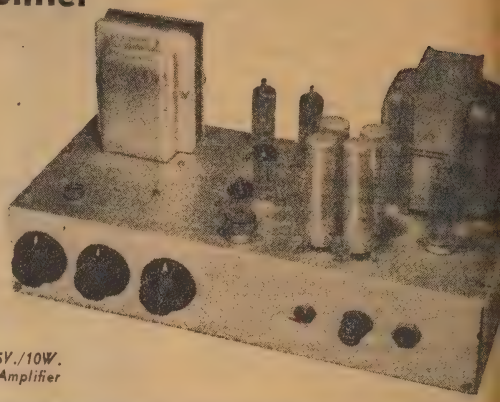
Bass Control: Continuously variable control of bass from +11db to —5db at 20 c/s.

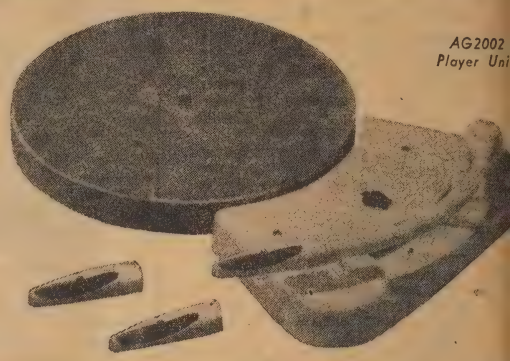
Companion unit to the Mullard 5-10 amplifier is the AG2002 low cost, 3-speed player unit. This world-wide popular high quality player is now made in Australia and features an extremely low rumble level yet high torque. Standard equipment is a dual stylii head but individual microgroove and 78 r.p.m. plug-in heads giving an even wider range are available. For the most fastidious, there is a microgroove head with a diamond stylus.

Designed by valve applications engineers for quality performance at low cost, the construction of the amplifier is fully described in Mullard publication MV8104 now available in your State for 3/9 (post-paid, 4/3).* This booklet also contains details of the AG2002 player, equalisation networks and an outstanding horn-type loud speaker enclosure. The latter enables the use of low-cost speakers — surprising performance from the inexpensive, locally made speakers recommended in the Australian section of the booklet.

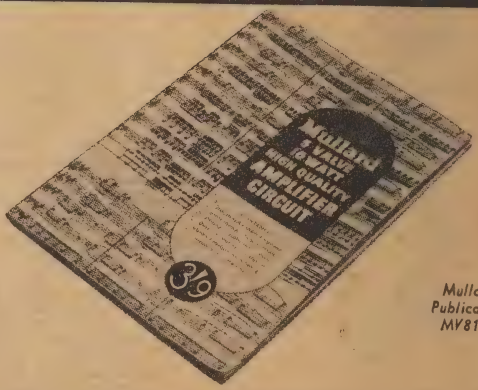
**Mullard does not supply the assembled amplifier or a kitset, but the complete 5-10 amplifier kit including an approved output transformer can be obtained from Electronic Products, Box 28, Post Office, Punchbowl, New South Wales.*



5V./10W. Amplifier



AG2002 Player Uni



Mullard Publication MV8104

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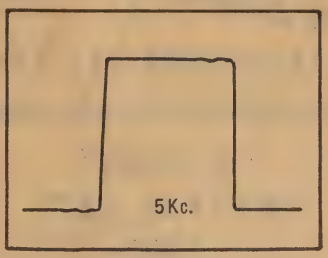
M18a

e output plates and cathodes. If
tuner is used, a 100 mill rating
ill be enough But as the tuner
ight well run to another 20 mills,
e rating should be increased by
is amount if you want the radio
well.
The 5000 ohm resistor will drop
e tuner voltage to about 230 volts,
id an extra 8 mfds decoupler is
ided for safety.
The only difference in the output
nnections for UL work is to con-
ct the screen tappings to the cor-
ct sides of the circuit, as indi-
ted by the manufacturer. If you
t them crossed, the circuit will
cillate.
Separate bias resistors are used for
e output values. With valves
ving a high mutual conductance,
is is often a good idea to allow
e automatic bias to compensate
r current variations. It makes
ttle difference to distortion unless
e valves are appreciably unbal-
nced.

ATHODE BYPASS

High value cathode bypasses are
sed to hold up the bass response
id avoid phase shift at low fre-
uencies.
The feedback resistors are differ-
nt for each circuit because the
in is greater with the pentode con-
ection. The exact value of the
hase correction condenser marked
ith an asterisk will depend on
e output transformer, and we
ave given the value used with the
ansformers shown. If you are in
oubt, 47 pf should be about right.
he values given were chosen for least ringing and best square-wave performance.

We built our amplifier on an aluminium chassis which is easier to work than steel, but there should be little difference between the two, particularly if care is taken with the single-point earthing of the first stage.



This is a square-wave tracing of the U-L amplifier at a frequency of 5 Kc. It shows almost complete absence of overshoot and ringing, and illustrates the good over-all frequency response.

Blue-prints will be supplied to the chassis makers so that you can order your chassis in the normal way.

We do not intend to indicate mounting holes for either the power supply or the output transformer, because there are a number of makes available, and unfortunately their mounting arrangements are not standardised.

But it is usually not a matter of great difficulty to drill suitable holes on the chassis, and we have taken care to leave enough room for any of the well-known makes.

The same point applies to output transformers. Some require rectangular cut-outs and some need only holes to allow the leads to pass through.

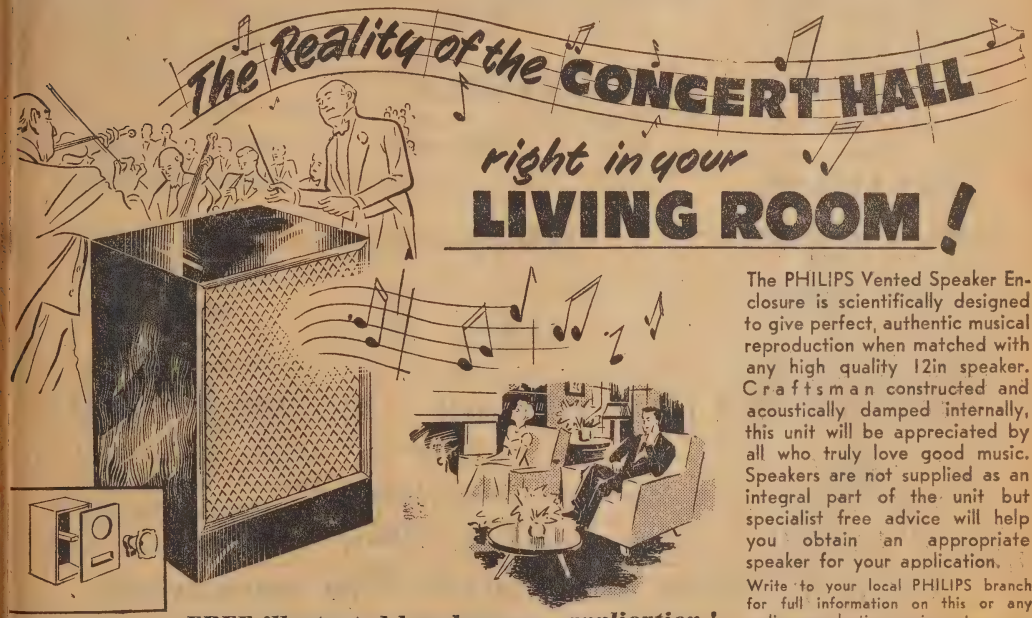
A cut-out can be made quite easily by drilling an outline with holes which almost overlap, knocking out the section, and cleaning up the ragged edges with a file.

FRONT END SHIELD

The shield for the front section is simply a right-angled metal section fitting closely inside the width of the chassis. The vertical edge fits down just in front of the .1 mfd condenser wired to the 12AX7 valve socket, and clearly visible in the picture. If you look closely you will see the three holes in the chassis by which the three little feet are bolted to it, one at each end and one in the middle.

Clearly visible, too, are the two corner brackets, supporting the top fold of the shield. These are mounted below the chassis edge by an amount equal to the thickness of the shield metal, so that when in place the shield is flush with the bottom of the chassis. The brackets are tapped for 1-8in bolts, using countersunk heads set flush in the metal.

The underchassis photograph shows also the lead to the tuner at the right, and the filament and feedback leads running back near the centre of the chassis. A third set of leads run between the first



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wo sockets—they are the plate-id coupling connection and the ngle-point earth lead. Thus you ill need three little nicks cut in ie edge of the shield to give them ee passage.

The feedback resistor and its con-enser are mounted on the two un-sed pins of the 4-pin speaker ocket.

The white circle seen near the F86 valve socket is the plate de-oupling condenser standing on its nd, so that it is earthed to the ommon earth wire, also clearly isible.

The controls are fitted with iedium-sized knobs, and details of ie escutcheon plate will be supplied o advertisers so that one may be rdered in the usual way.

The feedback resistor values are iven for 15 ohm speakers which re generally characteristic of ietter types.

For 8 ohm speakers the resistance alue should be reduced to two-hirds the value given, and for -ohm speakers to one third. The hase-correction condenser should e increased by a similar amount.

CIRCUIT BALANCE

For accurate balance in the phase hanger circuit, the two plate resist-rs, specified as .1 meg (5 pc toler-nce), should be of different values. n most cases it will not be essen-ial to worry about it as the un-alance is unlikely to exceed a few er cent.

If you are keen to compensate for this point, it should be noted that the plate resistor of the sec-tion which has the grid grounded through the .1 mfd condenser, has the larger value.

With a valve such as the 12AX7, the difference in value is estimated as 3 pc, which means that a 3000 ohm resistor should be included in series with the .1 meg plate load to achieve perfect balance.

It is a good plan to measure your two resistors on an ohm-meter. Se-lect the one which has the larger value for use in this position, if it is possible to detect any dif-ference at all with 5 pc resistors.

FILAMENTS

If you have reason to believe the difference is equal to something like 3000 ohms, no extra resistor need be used, as there is no point in having the .1 values accurate to microscopic limits. It is the small difference in value which is im-portant.

Note that the tapped 6.3V wind-ing of the transformer is the one to use for the EF86, as a balanced earth connection is valuable in re-ducing the danger of hum in high gain audio circuits.

This winding is also used for the tuner to balance the drain be-tween the filament windings, and it is therefore important to see that the filament circuit in the tuner is not connected to its chassis. To do this would be to short-circuit one-half of the winding.

The Playmaster tuners were all designed without a filament earth, but if you use a different type of tuner you should watch this point.

There is no advantage to be gain-ed by centre-tapping the second fila-ment winding, which feeds the last three valves.

Nor is there any improvement to be noticed by returning the centre-tapped filament to a positive volt-age, as was done with many of the Playmasters. Some of these de-signs ran with a sensitivity much higher than that of the two de-scribed here.

THE PICK-UP

The selection of a pick-up must be a matter of individual choice, and it is an obvious remark to say that the best pick-ups sound best. They generally have a lower out-put than the standard twin-stylus cartridges, but we have used the amplifier with a number of types, and they all provide ample volume on standard discs.

It is quite worth while to buy a good speaker for use with these amplifiers, as their performance will show that they both merit it. Here again cost and personal preference comes into it.

Adequate baffling is quite essen-tial for any such speaker, and the makers often provide designs for suitable enclosures for use with their speakers.

If you are in any doubt about the value of feedback resistor re-quired for any given speaker, it should be of such a value as to give a gain reduction of between five and six times when connected into circuit.

If you find you have more volume that you can use, it is quite in order to use a higher reduction fac-tor which will, of course, give more feedback.

It should rarely be necessary to push this factor higher than 10, which represents 20 db of feed-back, although both amplifiers will be quite stable with this amount.

PERFORMANCE

A few figures about the amplifiers tested without the compensation cir-cuit will be of interest. With each amplifier the square wave shape was extremely good. We have given a tracing of the wave-form of one UL version taken at 5 Kc, showing an almost perfect pattern. The pentode circuit was quite comparable, al-though we would expect better linearity and lower distortion with the UL connection.

A typical response curve for one of the transformers tested showed a flat response to 90 Kc, 1 db drop at 125, 2 db at 140, 3 db at 175 and 6 db at 210 Kc. Some trans-formers did better than this. This performance is only bettered by our best amplifiers using the highest quality parts, and in any case com-pares very well with the best com-mercial standards.

Power output of the pentode am-plifier was 16 watts at 1 Kc. Out-put of the UL version was 13 watts at 1 Kc, and 9 watts at both 20 cycles and 10 Kc. Input sensitivity at the grid of the first valve was 50 milliwatts, and the effective plate voltage 300 volts. The feedback was 15 db to which must be added the feedback provided around the output stage by the UL connection. This is enough to reduce distortion to a negligible amount.

Hum level is so low that, even with an ear at the speaker, it can barely be heard.

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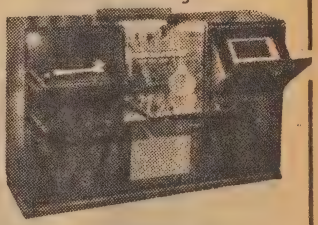

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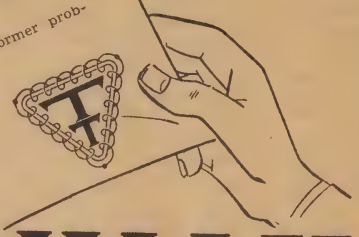

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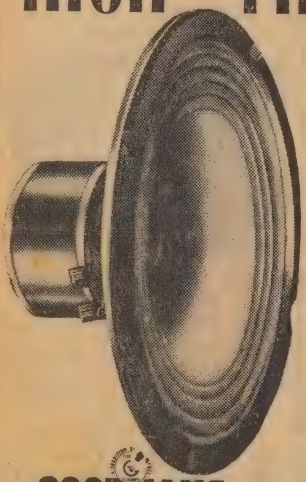

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FROM THE SERVICEMAN WHO TELLS

Following the publication last month of a letter from "A Serviceman With a Grouch" I have received a number of letters from other servicemen similarly afflicted. On the technical side I have one of those out-of-the-ordinary jobs concerning a movie projector.

THE most representative of the letters I have condensed as far possible and you will find them ublished on other pages of this rticle.

One interesting thing about them the variety of opinion they express. this does nothing else it proves my ntention, expressed last month, iat no one person is competent to ake sweeping statements about parcular sets being "good" or "bad".

Another point is the difference of pinion regarding the quality of those ets carrying well-known brands. ome writers, like Mr. G.F., of Calundra, express the opinion that the ults of which F.J.C. complains occur mainly in the cheaper unbranded ets and that the quality of the better nown brands is of a high order.

EST AT FAULT

Others, who seem to be in the majrity at this stage, are emphatic in heir condemnation of many points ssociated with the best known rands. Since they make specific oints such opinions cannot be comletely ignored.

Mr. G.F.E., of Yungaburra, North Queensland, does not entirely agree vith F.J.C. regarding point-to-point viring and raises some interesting oints on this subject. He is also able o put the case of the serviceman in he tropics; a person whose ideas, I ear, are not always taken as seriously by manufacturers as they might e.

And so it goes on! The specific details are different but they all have a grouch. Are they all merely "having a winge", or could the set designers really improve things by doing a better job?

What do you think?

Before detailing my technical problems this month I should really don my Boy Scout's outfit, complete with oversize scarf to accommodate several knots, each indicating the traditional good deed. (Or perhaps the knots should be untied to indicate a good deed—blessed if I can remember now.)

BOY SCOUT ACTS

Anyway, remembering the rush job I had to do recently on an amplifier for an Anzac Day service, together with what I am about to relate, it seems that I have been doing enough good deeds lately to last the average Boy Scout for some time.

Not that I mind really, except that it usually means working under difficulties and without the equipment to do a proper job. On the other hand they usually yield an interesting story which is one reason why I am often "persuaded" to tackle such jobs on a Sunday afternoon. (The fact that Mrs. Serviceman may have made some pertinent remarks about the state of the lawn could also be a factor.)

This case did, in fact, happen on a recent Sunday afternoon. I was just trying to work up enough energy to tackle the said lawn when a knock on the door provided a first class excuse for leaving it until the next weekend.

My caller was in real strife. It seemed that he was in charge of a 16mm projector used by a local charity and the projector had let him down at the last minute.

He told me he had spent the previous half-hour or so making up his program, using the power re-wind feature which is normal with all such machines, only to discover after winding a couple of reels, that the machine now refused to run in any direction but reverse. The show was due to start in a few hours and could I possibly help?

I could appreciate how he felt. Not only would he have to pay rent for films he could not show but he would also disappoint his audience and destroy valuable goodwill.

Of course, some films are more entertaining shown in reverse, and some would be hardly affected. (I understand that Johnnie Ray's films look—and sound—much the same in either direction). At the same time one could hardly expect an audience to sit through a couple of hours of documentaries run backwards, even for the most deserving charity.

I said I would see what I could do.

To be quite honest, my experience with such machines is strictly limited. I am familiar with the general principles involved, of course, but have little knowledge of the specific details of any particular make.

In the normal way it would have been about the last thing I would choose to service at short notice and without a properly equipped bench. But I reasoned that a fault of this

SOME PET HATES

Dear Sir,

Why must assemblers in radio factories twist pigtails around lugs a couple of times before soldering? I've assembled a few sets and pieces of test gear, and have never had any trouble with solder breaking away if the pigtail is just pushed through the lug and soldered, or at the most given a right-angled bend and cut off short.

To test a fixed condenser for leakage when it has had its lead twisted around excessively, one is forced to cut the wire off short and then to rely on the solder alone to hold if he finds the part does not require replacing.

Twisting the wire around a valve socket lug, especially on the miniature sockets, means that pulling on the pigtail with long-nosed pliers while applying the iron to the lug is quite ineffective. One either breaks the lug off, or cracks it so that it will break later.

I dislike the ceramic (so-called) trimmers. I mean the kind consisting of a piece of thick wire in a ceramic tube with a fine strand of tinned wire wound around the tube. They may be cheap to make, but are certainly time wasters to tune.

If you want to increase the capacity it is usually necessary to solder a strand of flex to the end of the fine wire while, if the tuning is very much out and the capacity must be reduced a few pico farads, you finish up with a length of wire hanging loose and necessitating an amputation.

Recently I tried to align one of the new IF transformers with the internally threaded type of former, the slugs being slotted for adjusting. Someone either in the factory, or maybe another serviceman, had sealed the top slug so tightly that in trying to turn it I only succeeded in turning the former and breaking off the leads to the pins.

Valve sockets under wave change switches are no doubt efficient for the sake of short leads, but they can be a headache for the serviceman if any soldering has to be done around them, or the socket has to be replaced by a new one.

Some wave change/gramophone switches are so constructed and fitted that it is impossible to remove and replace single wafer sections without taking the whole switch out, often a long and costly undertaking.

I don't like the no RF stage receivers sold in low field strength areas such as this district. They're not as selective, more affected by fading, AVC notwithstanding, and have a higher noise level in daylight.

But I realise that if there were no faults in design there would be fewer jobs for the serviceman. Of course, examples of poor design are sometimes bad for business, such as the poorly designed dial drive that breaks cords until a chap has to modify the thing in some way to keep faith with the customer.

Apart from such things, I have no intention of trying to tell manufacturers their job. Their mistakes bring me business, and after all, as you say, some sets never come to the repair shop. If all sets were like that some of us would have to go back to navvying.

Yours truly, R.L.K.

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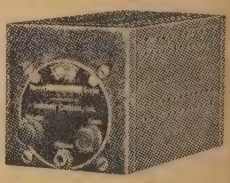

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RADIO SERVICE IN THE TROPICS

In the first portion of this letter Mr. G.F.E. expresses the opinion the radios produced since the war have shown considerable improvement in those matters which were raised by F.J.C. In support of this contention he cites specific cases of receiver types which were popular (though not with servicemen) before the war but which have since been discarded. He goes on to say:

The main points I find left to complain about are three in number. These are:

(1) Dial systems. These leave much to be desired in 70 pc of the sets I see.

I have one in mind that has a sticker on the dial back plate, that says "—take 4ft of cord and thread up as in diagram—" The backlash in that dial system is measurable in seconds, before the pointer starts to move after turning the tuning knob. Yet this is in a £35 odd, model from the "——" factory.

I suppose that 50 pc of the dial systems I'm called to fix could be classed in the inaccessible division.

Personally, I'm all for geared drive between the knob and the gang, and as short a cord system as possible for the pointer. There are several manufacturers turning out such sets today, but they spoil the effect by not supporting the needle in a positive manner.

(2) Sets in which the layout is good from a servicing angle, but mechanically bad. Most of these are radiogram types and have the chassis mounted vertically.

Invariably they have a row of rectifier and output valves mounted below the speaker transformer. The heat melts out the pitch, which flows all over the parts below the transformer, and the floor below. Very choice in the case of wall-to-wall carpets!

In this climate up here, the humidity then seeps into the space vacated by the pitch. The result is generally a good case of electrolysis in the windings, and my appearance on the scene to try and clean up the mess.

(3) Here I'm afraid that I must come to blows with F.J.C. It would seem that he is right against sets that have laced-up wiring forms, if one reads his comments about point to point wiring correctly.

Form wiring depends for its success on two factors. It must be properly laid out in the first place; secondly, the material used must be first class.

From experience in home radios and cheap commercial gear, it is in the quality of the insulation on the wire used that the scheme falls down.

In this regard I have found "——" fall down dismally, as one manufacturer who uses form wiring. They use low grade rubber insulated wire. After a couple of years in Queensland it either drys out and cracks, eventually letting lumps of rubber fall off, and thus allowing the wires to short, or it goes semi-liquid with a similar end result of shorting wires. The only answer is a complete rewire of the set.

Yet in high-grade equipment, I have found it gives excellent service in some cases for 20 years, and no fault yet having occurred.

Mr. G.F.E. concludes by suggesting that the experience of servicemen should be pooled to draw up a set of standards for the guidance of manufacturers. Among other things this should consider the climate in which the equipment is to operate, an example being the futility of using paper wrapped condensers in the tropics, these often falling to .05 meg. leakage, even when new.

had implied a relatively simple fault, probably in one of the switches, which should not be hard to track down.

The operator had brought the unit with him in the car, and we set it up on my home workbench and checked it. Sure enough, it flatly refused to run in forward, though it seemed to run in reverse quite reliably.

The change of direction was achieved by means of a two-position switch, and removing the base plate showed this to be a two-pole two-position toggle type. Leads from it disappeared through the top of the base to the motor, and I assumed that they were either field or armature connections, since reversing either would reverse the motor.

SWITCH FAILURE

It did not take long to confirm that one-half of the switch had failed, and I removed it for a closer look. It was quite obviously a replacement, being one of the cheaper locally-made models of a type never intended for work of this kind. Just why it had been used I was hardly likely to discover, since the machine had presumably been through many hands.

In any case, I was more concerned with the moment with getting the thing going. I searched through my box of switches and seemed to have every type of switch except a double-pole, double-throw.

I explained the difficulty to the operator and suggested that I could wire the motor to run forward only, purely as temporary measure to carry on the show. He wasn't over keen on this, pointing out that he still had a couple of reels to be rewound before the show could go on, plus the need to rewind most of them again before returning them to the film exchange.

I could see his point. Films can be wound by hand by the simple procedure of inserting one's finger in the spool and pushing it around, but it is a slow and exhausting process, with a high order of wear and tear on the finger!

The only other approach seemed to be to try to repair the switch. Fortunately, it was of the type held together with four small screws, and removing these allowed me to remove the top plate holding the lever mechanism and the moving contact. The fixed contacts were held in the moulded base.

CONTACT TROUBLE

Once apart, the cause of the trouble was fairly obvious. The fixed contacts on the forward-run position were in a really bad way, being completely devoid of tension. Nor was it any use to bend them back into their correct shape because they had no springiness left.

The contacts appeared to be made of light-gauge brass and it seemed that they were simply not capable of carrying the required current continuously without overheating. Once they heated, some of the temper was drawn from them, and the effectiveness of the contact impaired. This meant more heat, still poorer contact, and so on, until it failed completely.

The contacts on the reverse position were in better condition, probably because they would normally be used for much shorter periods and thus be less likely to heat up. From their condition I judged that all the contacts had originally been quite springy, but that the load had just been too much for them.

In fact, it was possible to judge the condition of each contact by plucking it with the point of the screwdriver and observing the resultant "plink". In the case of the faulty contacts, there just wasn't any "plink".

There seemed to be no future in trying to doctor the existing contacts; they were so soft that they simply remained in whatever position they were pushed. It was almost certain that they would not last more than a few minutes, let alone a couple of hours. The situation looked rather grim.

Then I had a brainwave. Somewhere in another junkbox was a packet of shim brass I had once bought for use on the family car. I seemed to remember one sheet of the assorted gauges which would be about the same thickness as the contacts. If only I could find it.

After a few false leads, I eventually tracked it down, fished out the thickest sheet and compared it with the contacts. It was near enough and also appeared to be quite springy. I reasoned it would see the show through, at least.

Next, I swiped the household scissors (while Mrs. Serviceman wasn't looking), and proceeded to cut some fresh contacts. It was not particularly difficult, since the contact was simply a strip about 3-16in wide and 5-8in long. These strips fitted in slits in the moulded base, one end forming the contact and the other an external solder lug.

A certain amount of shaping was called for, there being a kind of retaining "V" pressed into the centre of the contact. The final result was a bit rough, when compared with the original, but I felt that it would work, at least long enough to finish the show.

OPERATORS REACTION

Naturally, the operator was hovering around all this time, glancing occasionally at his watch, and quite intrigued by the process of making a new set of contacts. I imagine he was quite surprised to realise that such a repair could be made using relatively simple tools and materials.

I reassembled the switch, checked it with an ohm meter, and then wired it back into the projector. This time everything went as it should, and

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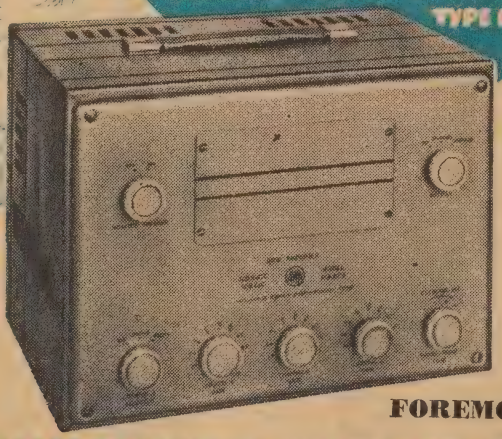

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e switch appeared to be quite re-
ible in both positions.

Conscious that there was little time spare, we loaded the projector back the car, together with a soldering on, multimeter, a handful of tools, d some short lengths of wire.

In point of fact, everything went noothly and the operator was able set up the gear, re-wind his re-aining films, and start the show on me. I went along and stood by case of trouble. I also enjoyed e show, which was some compen-tion for my disturbed Sunday fternoon.

But there was more to it than that. he operator was clearly shaken by hat had been a rather close call. fter all, I could easily have been ut for the afternoon, or, for various easons, unable to help him.

OO RISKY

"I can't afford to risk breakdowns ke that," he said. "These shows re just becoming well known, and a t-down at this stage would be the orst possible thing that could hap-en. I would like to get the best uality switch available; price is no bject."

He went on to say that this inci-ent had made him realise that one f the other switches might also be roggy. It had never actually failed, ut it had "hesitated" on occasions. le would like that changed also. I uggested that he drop the projector nto the shop the next day and I would check it over and fit in some-hing more permanent.

The next day I was able to study he switches in a more leisurely 'ashion and decide what would be uitable replacements. There were hree altogether; the one I had re-aired, one for the projector lamp, nd a main switch normally used for tarting and stopping. This latter was he one that was "hesitating".

Considering the load it had to carry his was not surprising. It was a louble-pole, single-throw type, with one pole completing the amplifier HT circuit from transformer centre tap to chassis and the other pole the lamp and motor circuit.

This was a very convenient arrangement from the operator's point of view, since it permitted the show to be started or stopped with only one switch. With all other switches and controls correctly set, the closing of the one switch would simultaneously start the motor, switch on the projection lamp, switch on the amplifier, and, indirectly, switch on the exciter lamp, the latter operating from an audio oscillator as part of the main amplifier.

SEPARATE SWITCH

The separate projection lamp switch permitted the lamp to be turned off (but not on) independently of the main switch, as, for example, when it was required to run the motor for re-wind purposes.

(I decided to replace this also. It has given no trouble, but it must have been as old as the others, and thus equally likely to pack up. Replacing it seemed the logical thing to do.)

All this switching was very interesting and ingenious, but I was mainly worried about the section of the switch controlling the motor and lamp. The lamp was a 110 volt 750 watt type, meaning that it would draw near enough to seven amps, while I estimated that the motor would probably draw another three. Thus it would have to carry 10 amps continuously, to say nothing of the extra starting current for the motor and lamp.

The lamp, particularly, has a heavy starting current, the cold resistance being only a small fraction of the normal running resistance.

It occurred to me that this could be the reason the particular switch had shown a tendency to hesitate. Assuming that it was introducing some resistance into the circuit, it is quite possible that the heavy starting current of the lamp would drop the voltage momentarily, thus preventing the motor from starting until the lamp had warmed up and reduced the drain.

"CHEAP" SETS

While I readily agree with F.J.C.'s criticism, I cannot agree with his idea of a public analysis of different models.

There always has and there always will be good and badly designed radio sets. If F.J.C. has, as I presume he has, made a close study of radio sets over a long period he will have observed that the design of radio sets has closely followed the public demand and their capacity to pay.

At the same time, reputable manufacturers have not sacrificed efficiency and quality in their sets and I doubt if F.J.C. has come across many of them judging by his grouch.

In my 20 years' servicing experience I have adopted a practice of classing radio sets as first or second class. Second class sets invariably consist of all the cheaper class sets, some of doubtful origin and without names, and they are certainly all F.J.C. claims in regard to design, &c.

As I am a serviceman I service all sets, first and second class alike, but I am careful to point out to the owner of a second class set the defects in design and the time involved to repair it. In no circumstances will I guarantee repairs on such a set.

However, why should we servicemen growl? The customer must pay for his indiscretion in purchasing a cheap and poorly designed set. So long as reputable servicemen sell sets manufactured by a reputable and well established manufacturer they have no kick coming. If all servicemen adopted such a practice it would in some small way help to promote better designed sets.

However, as I said at the beginning, while we have a population with varying incomes we will always have these cheap, poorly designed sets and with no comeback. A letter to the manufacturer (as suggested by the Serviceman) is generally impossible as the majority of these sets are devoid of name, model, or any identification mark of any kind. I can't blame the manufacturers here as I would not like to own up to even wiring one of these sets.

While sympathising with F.J.C. I can only say, Grab your soldering iron, do your best, and make sure you charge for all your time.

Yours Faithfully (G.F.).

Considering all these factors, I could only agree with the operator that only the best was good enough, and no expense should be spared. Accordingly, on my next visit to the city I visited a warehouse which I knew handled a line of high-quality imported switches. After due consideration of the types available, I selected three which I felt would be equal to the task. Rated at 10 amps, they were extremely well-made, robust devices which were a far cry from the flimsy one I had repaired.

They were not particularly cheap, of course, but I doubt whether the entire job, including labor, would cost much more than the film hire for a decent program, and it would certainly be far less than the profit from one show. In the circumstances, it was money well spent.

There is also a rather interesting sidelight arising out of this job. As I mentioned earlier, the cold resistance of a projection lamp (or any lamp, for that matter) is much lower than the normal running resistance.

In order to establish the exact order of this cold to hot resistance, I contacted an acquaintance who spends his working life among such devices and asked him if he could supply a few basic facts.

INTERESTING

Those he was able to supply are quite interesting, and I pass them on for readers' benefit. The first is that a projection lamp is, by normal standards, a grossly overloaded affair. This is essential in order to achieve the required brilliance and, more particularly, color temperature. This latter needs to be as near pure white light as possible, especially in these days of color films.

Naturally such overloads mean a shortened life, but this is regarded as secondary to the performance requirements. While aware of this in a general way, I was nevertheless surprised to learn that most lamps have a life expectancy of only 25 to 50 hours. While this seems short at first glance, it must be realised that the running cost will usually be small compared with the other expenses normally involved in such an undertaking.

Of rather greater importance is the need to have at least one, and preferably two, spare lamps always on hand. I say two, because apparently even a brand-new lamp can occasionally fail on switching on. Of course, the makers will doubtless replace it, but that is cold comfort at the time if a show has to be scrapped.

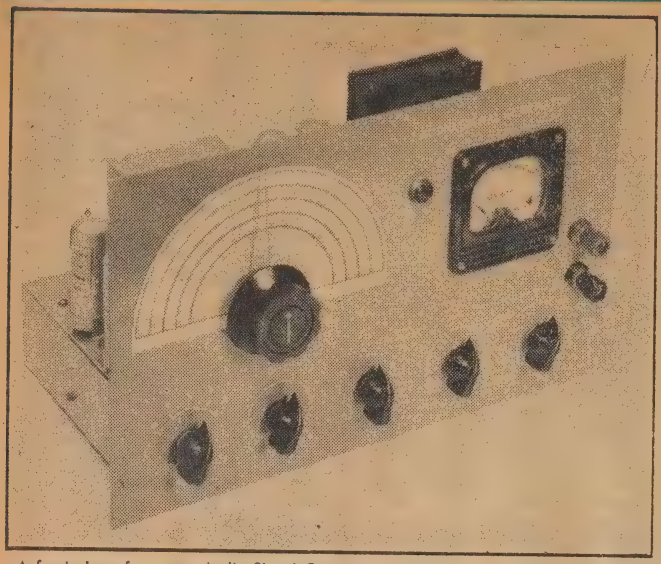
To obtain the best life from such lamps the makers recommend that they be kept as free from vibration as possible while switched on. It seems that the filament is in a condition only a little below fluid and vibration can easily cause premature failure. If the projector or the lamp have to be moved while switched on (as when lining up the projector or optical system) it is recommended that the lamp be operated at reduced voltage.

100 AMPS!

The figures for the cold resistance of the lamps were quite startling. A 110-volt 750-watt lamp, such as used in the aforementioned equipment, has a cold resistance of 1.05 ohms. This means that at the moment of switching on it is likely to pass more than 100 amps!

Although this is only momentary, it

(Continued on Page 57)



A front view of our new Audio Signal Generator. The design of such an instrument is discussed in the following article. Next month, we will tell you how to build it.

DESIGNING AUDIO GENERATORS

In this and the next issue, we propose to discuss the design and construction of a modern audio signal generator, suitable for laboratory use. It features extremely wide frequency coverage, sine and square-wave output, VT level indicator and an accurate low-impedance output attenuator.

by Reg. Rawlings

DURING the past two or three years, considerable progress has been made in the design of audio amplifiers, as well as the equipment used with them—pickups, speakers, records and the like. This much will have been evident from recent articles in this magazine, particularly those dealing with the new "Ultra-Linear" amplifiers.

Naturally enough, the testing of such amplifiers places more stringent requirements on the test equipment itself. That is why we modified our oscilloscope a few months back, rechecked other items of equipment and built this new audio generator. Inevitably, others concerned with testing amplifiers will be faced with similar problems.

WIDER RANGE NEEDED

A few years ago, it was considered sufficient to check the response and distortion of an amplifier with sine-wave input between the limits of 30 cps and 20Kc.

Now we want to know about the performance at much lower and much higher frequencies, as a pointer to the general stability of the design. We want to observe its performance with square-wave input, as an indication of its behavior when reproducing the transient characteristics of speech and music.

We don't propose to "Buy An Argument" at this stage as to how much "overshoot", "ringing" (and even "rumble"), one can tolerate—and with what auxiliary equipment! Our object is purely to devise test equipment which will reveal these characteristics as far as possible, leaving the results to be interpreted by observation and experience.

At the bass end, as far as music is concerned, our interest does not extend below about 20 cps, and this is a suitable frequency at which to observe the low frequency gain and power output of an amplifier.

The response below 20 cps is still significant, however, because a rise in gain, particularly below 10 cps, may indicate regeneration through common power supply impedance or phase rotation in a negative feedback loop. This may lead, in turn, to motorboating troubles when a preamplifier has to be added, or perhaps a radio tuner.

While it must, therefore, be agreed that an audio generator should ideally operate down to very low frequencies, it is, unfortunately, true that it is an extremely difficult requirement to satisfy—assuming that the output must be level, stable and undistorted.

In practice, one must often be prepared to settle for a lower limit at about 20 cps, bearing in mind that a square wave at this frequency can indicate something of the amplifier's performance lower down in the range.

UPPER LIMIT

At the high frequency end, it is essential nowadays to be able to check the amplifier's response, including the output transformer, to at least 250Kc. Peaks in the response in the supersonic region normally lead to ringing and overshoot on transient waveforms.

A generator coverage to at least 250Kc was therefore accepted as a basic requirement, without overlooking the possibility that it might usefully be extended beyond this figure.

Also with a view to revealing transient characteristics, it is desirable that the generator be capable of producing good square waves to at least 5000 cps—again with the possibility in mind that useful square waves would be available at still higher frequencies.

Such then are the requirements of coverage.

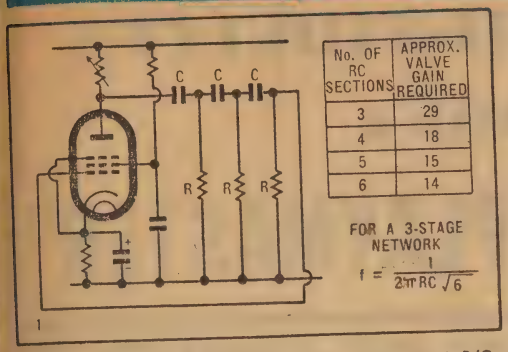
It was also considered essential that the output voltage from the oscillator, be substantially constant over the whole of its range to obviate the need constantly to readjust the output level. If this requirement could be met and an accurate attenuator and valve voltmeter fitted, we would thus have the main essentials of an excellent instrument.

OTHER FEATURES

Other desirable features of an instrument of this type are freedom from hum output and the resultant locking in to the mains, stability of frequency calibration, smoothness of frequency control, and freedom from hunting of the output level with change of frequency. How these requirements were ultimately met will be described.

Many types of audio oscillator have been produced at various times, each with their own advantages and disadvantages. Thus, when the initial design of this oscillator was commenced, many possible ways of achieving the final result were available, so that each needed to be

DIAGRAMS ILLUSTRATE TYPICAL R/C OSCILLATORS



No. OF RC SECTIONS	APPROX. VALVE GAIN REQUIRED
3	29
4	18
5	15
6	14

FOR A 3-STAGE NETWORK

$$f = \frac{1}{2\pi RC\sqrt{6}}$$

Figure 1: Basic circuit of the phase-advance type of R/C oscillator. In its simple form, the circuit is not very suitable for use in a variable frequency oscillator.

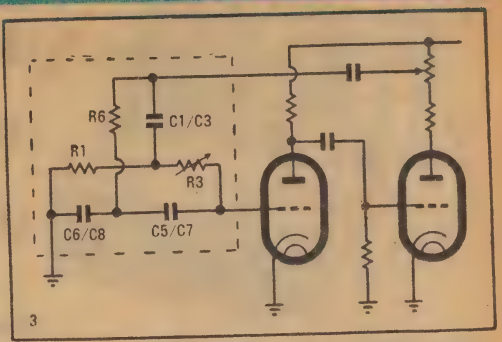


Figure 3: The "parallel-T" oscillator, as used in many simple audio oscillators. Main difficulty with the circuit is in achieving level output without AVC "hunting" effects.

carefully considered to decide upon the best line of approach.

At audio frequencies it is impracticable to use variable LC circuits, in view of the large values of inductance and capacity which would be required. Where continuous variation of the frequency is not necessary, the scheme is quite satisfactory and has, in fact, been used in at least one commercial instrument.

FILTER TROUBLES

Up till recent years, the almost standard method of producing audio frequencies was to beat two radio frequency waves together and utilise the resultant. The minimum requirements for this circuit are two identical oscillators usually operating at about 100 Kc, a non-linear mixer, a buffer amplifier to feed the low-pass filter, and suitable output stages.

In general, unless the filter is of particularly good design and the internal screening of the oscillator good, a significant amount of 100 Kc waveform appears together with the audio at the output terminals.

The two oscillators themselves must be of identical design and layout, if excessive drift is to be avoided. They must be well screened from each other if they are not to lock in at low frequencies, or, at the least, produce objectionable low frequency distortion.

In any case, the ratio of inputs to the mixer must be carefully chosen, as well as the mixer circuit arrangement, to minimise waveform distortion.

BFO ADVANTAGES

Against these disadvantages, a well-designed BFO can produce extremely low frequencies, calibration being readily checked against the power mains and/or zero beat. The entire audio band can also be covered in a single sweep of the dial. While this has always been regarded as an advantge in conventional BFO, it could scarcely be retained in an instrument designed to cover to several hundreds of kilocycles.

The more recent approach to audio oscillator design is by the use of resistance-capacitance frequency determining circuits.

The simplest of these is the single-valve phase-advancing type shown in figure 1, the R/C network forming a feedback path between plate and grid.

The circuit shown has a three-section network, which represents the minimum practical number. However, four or more sections may be used, the gain required for oscillation being less as the number of sections is increased. Beyond four sections, the drop in gain required is quite small and more sections than this are rarely used.

For the circuit to oscillate, the required phase change through the RC network is 180 degrees. This gives a voltage feedback which is positive at the grid. If sufficient gain is obtained between the grid and anode of the valve to overcome the loss in the RC network, oscillation will take place.

GOOD RESULTS

In practice the necessary gain is easily obtained with a pentode and the circuit is set up by varying the plate load of the valve until oscillation is obtained. The writer has had very good results with this type of circuit, it being very easy to get going and stable in operation, with good output waveform.

In order to vary the frequency of this oscillator it is necessary to vary three elements at least. This is rather impractical in the case of the capacitors as there is no common connection. The resistive element can be varied, but there is some limit to this, because the variable loading alters the gain of the amplifier over the range.

To avoid this difficulty, a cathode follower can be interposed between the amplifier and the phase changing networks but it is required to handle fairly high levels of signal and increases the complexity of the circuit.

PHASE ROTATION

A further type of oscillator which depends upon phase rotation for its operation is shown in figures 2a and 2b. The first diagram may not appear to have any bearing on the circuit at first sight but it is the basic phase rotation circuit upon which the operation of the oscillator is dependent.

Due to the phase inversion across the transformer secondary and the influence of the R/C network, there appears across the output terminals of this circuit a voltage variable in phase from approximately 20 to 160 degrees; this for constant output level, with no loading across the output.

In the valve circuit of figure 2b, the transformer secondary is replaced by a cathode-follower phase splitter with equal cathode and

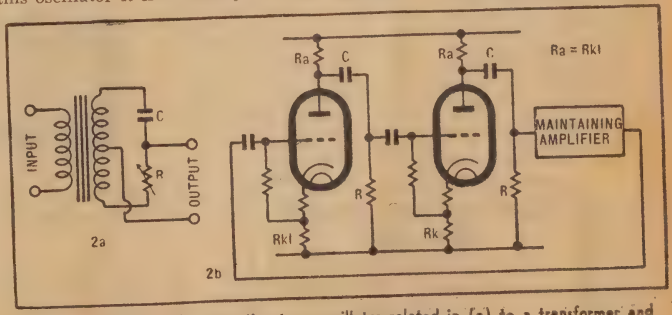


Figure 2: The basic phase-rotation type oscillator related in (a) to a transformer and (b) to a valve type phase splitter. An oscillator using this basic principle was described a couple of years ago in this magazine.

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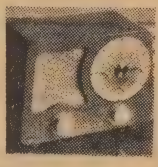

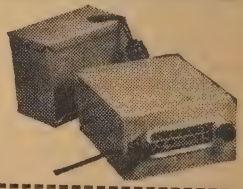

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late loads. By putting two such tages in cascade, it is readily possible to double the aforementioned gures of phase rotation, though the usual objective is 2 x 90 or 180 egrees.

It is necessary then only to place maintaining amplifier between the nds of the network to obtain an scillator whose frequency is controlled by varying either R or C as ganged pair. An oscillator using his principle was described in the August, 1953, edition of this magazine.

The main difficulty with this type of oscillator is in maintaining constant output, since the phase changer circuit does exhibit some variation in output level. This occurs at the extreme limits of the frequency controls, where the adverse loading effects are most apparent.

PARALLEL T CIRCUIT

The Parallel T network has also found its place as an audio oscillator and, in fact, an oscillator using this type of circuit was described in the July, 1949, issue of Radio and Hobbies.

This network has the property of having almost zero transmission loss at one particular frequency. If, then, it is connected in an amplifier positive feedback loop, oscillation will take place at the critical frequency of the circuit.

The basic requirements of this type of oscillator are shown in figure 3 and the components are numbered as in the original R & H article.

As can be seen there are six elements in the frequency determining circuit. While it is not necessary to change all the component values to alter the frequency and, in fact in the R & H oscillator varied only one, this is very much a compromise solution.

The result is the tendency for large output voltage changes over the band, unless quite large AVC control voltages are used with their attendant hunting difficulties. Also one is limited to resistance variation for frequency control which, while giving a reasonably smooth control with a carbon potentiometer, is not very satisfactory for a precision type instrument.

Of course, if only single frequency operation were required, the circuit could be a very satisfactory one.

WIEN BRIDGE

The last of the resistance-capacitance types is the Wien Bridge. An audio generator using this principle was described in the April to August, 1945, issues of Radio and Hobbies and has given a good account of itself ever since.

Since the original instrument was made, there have been many advances in the design of valves and components and it was thought that much improved performance could be obtained.

The basic Wien Bridge circuit is given in figure 4.

At one particular frequency the circuit will oscillate because the positive feedback from the plate of V2 to the grid of V1 exceeds the amount of negative feedback through R3 to the cathode resistor (R4) of valve V1.

This will occur at one frequency only, which is the frequency at

BASIC WIEN BRIDGE OSCILLATOR

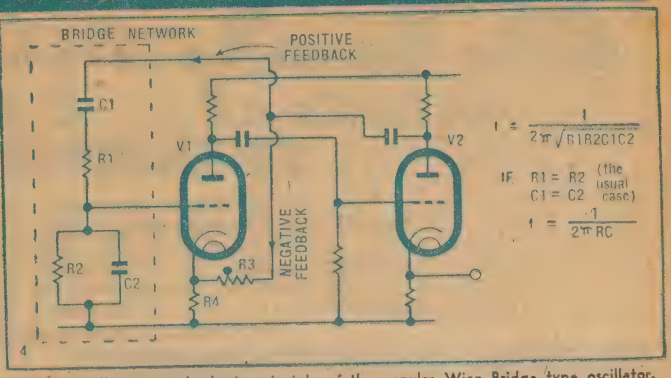

Figure 4: Illustrating the basic principle of the popular Wien Bridge type oscillator, which lends itself to ready application in good quality audio signal generators. See figure 5, below.

which the voltage across R2, C2 is in phase with the voltage across the whole Wien Bridge network. This latter voltage is also the output of the circuit if it is considered as an amplifier.

The frequency of oscillation is determined by the values of resistance and capacitance in the Wein Bridge network. The two resistors are usually kept equal in value, likewise the two capacitors but either pair may be varied for purposes of frequency control. In other words, the circuit usually calls for a dual variable resistor or a dual variable capacitor.

We preferred the latter arrangement because large diameter dual wire wound potentiometers are not easy to obtain and they must be wound with very fine wire if the control is to be smooth. The capacitance values in this circuit can, with careful design, be such that a standard receiver tuning gang can be used.

NEGATIVE COEFFICIENT

The availability of negative temperature coefficient resistors has also helped a great deal in this type of circuit to control the oscillator level. Such a resistor can be made to increase the negative feedback automatically if the output from the oscillator tends to rise—and vice versa.

They are much superior to either lamps or audio AVC circuits for controlling output and can easily be applied.

To give some idea of the resistance change obtainable, the component used in this oscillator varies from 50,000 ohms at no load to 100 ohms at 100mWatts.

Figure 5 shows the actual circuit of the Wien Bridge oscillator in our new audio generator.

CONSTANT OUTPUT

Fundamentally, if the oscillator is to have constant output at all frequencies, it must have uniform gain as an amplifier, and negligible phase change at all frequencies at which it is required to operate. For this reason high Gm television-type pentodes are used, with low values of plate load to maintain the high frequency response.

The plate load of the valve V2 must also be low, in order to provide a low impedance supply to feed the bridge network. On the highest

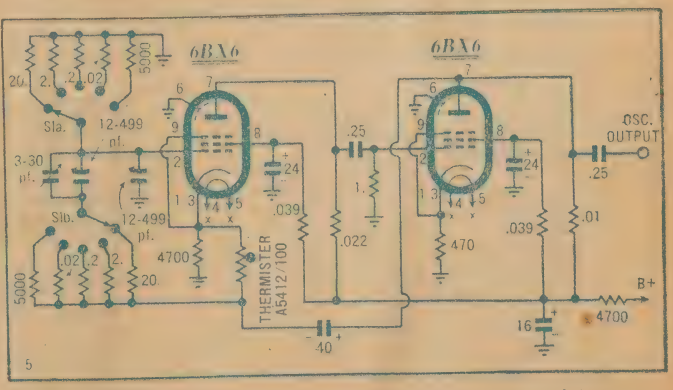

Figure 5: Here, in detail, is the Wien Bridge oscillator circuit used in our new generator. Use of type 6BX6 valves ensures wide frequency coverage without excessive demands on the power supply.

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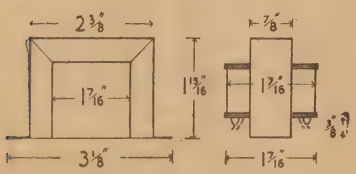

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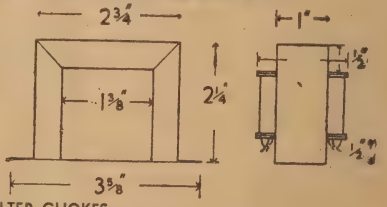

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frequency range, the impedance of the bridge circuit is itself quite low.

To maintain the low frequency response of the amplifier, large values of screen decoupling are used and cathodes are left unbypassed. Coupling capacitors are of high value and the capacitor in the negative feedback network needs to be of the electrolytic type to obtain sufficiently low impedance at the extreme low frequencies.

A high-voltage electrolytic must be used, because the leakage current of other types might affect the correct operation of the Thermistor, which is used as the automatic level control.

If the oscillator output tends to rise, more signal current flows through the Thermistor. The Thermistor resistance decreases and this, in turn, causes an even greater amount of feedback, which tends to reduce the output level.

In practice excellent control is obtained and in this particular instrument the output is held within very close limits over the whole of its frequency range. The circuit is very quick-acting and there is no evidence of hunting or settling down time, even when sweeping quickly from one end of a band to the other.

HUM VOLTAGES

Generous decoupling and smoothing of the B-plus line is required to keep hum voltages to a minimum. The simple centre-tapped pair of resistors across the filament supply was found to be all that was required to restrict pick up from this supply.

The whole oscillator section has to be completely screened and this was made easier in our case by using a miniature gang capacitor.

As the frequency determining resistors on the low frequency range are 20 megohms, it is most important that only low leakage insulation materials are used in the oscillator section. The frame of the gang condenser has to be insulated from the chassis and from the dial control spindle.

The capacitance from the frame of the condenser to the chassis must be kept to a minimum so it must be well spaced from the chassis and from the screen around it.

A ceramic wafer should be used for the range switch to keep insulation losses to a minimum and to obviate changes of calibration which would otherwise occur with conditions of high humidity. This effect is caused by the absorption of water by the insulating material, which tends to lower its resistance. This modifies to total circuit resistance and causes a change in the frequency of oscillation.

LOW RESISTANCES

For the same reason, a minimum number of anchor points are used for the resistors in the oscillator circuit. Where they are absolutely necessary, ceramic stand-off types are preferred.

The long term stability of calibration is dependent upon the stability of the components in the frequency determining networks. The gang condenser which was used in the original instrument had ceramic bead insulation and could be relied on to be stable in capacitance value.

The resistors should ideally be of the high stability cracked carbon type, with an original tolerance of plus or minus 2 pc. These are now becoming available on the local market and can be expected to be very satisfactory for test equipment uses.

So much for the basic oscillator.

In order to obtain a square-wave signal, it was decided to square the sine-wave output from the oscillator. A number of circuits can be used for this function, many of them quite complex.

A circuit which is frequently used is a two-stage over-driven pentode amplifier. A single over-driven pentode was used in the original Radio and Hobbies circuit but, at the higher frequencies, was found to suffer from rounding of the front edges. This was due to the input capacitance of the valve and the series grid resistor acting as a frequency-dependent divider.

The circuit used in the new oscillator is shown in Diagram 7 and gives excellent square waves up to 10Kc/s with a short rise time. The circuit is an over-driven cathode-coupled pair of triodes. As the circuit is regenerative, the two cathodes are disconnected from each other when the oscillator is switched to the sine-wave position.

To make the output of the generator approximately equal on square and sine waves, the output from the square-wave circuit is tapped down the anode load of the second valve.

In all, it is a very simple and satisfactory arrangement.

To isolate the oscillator from the attenuator and output circuit a cathode follower output stage is used. This consists of a pentode output type tube with the coarse attenuator connected in the cathode return.

This coarse attenuator gives four steps each having a multiplication of ten times. In the fifth position the output is shorted to ground to allow the valve voltmeter to be set to zero without the need to short the output terminals separately.

Fine output control is achieved by varying the input to the cathode follower. Whilst it is not possible to reduce the output of the stage to zero by this fine control it is reduced to well below the maximum output of the next lower coarse attenuator position.

OUTPUT CONDENSER

The output coupling condenser must be of high value if it is not to distort the square waves when the generator is required to feed into low values of load. In order to get the condenser into the oscillator cabinet at all an electrolytic type had to be used.

The leakage current of this condenser would cause, without the 10,000 ohm resistor, a voltage to be impressed upon any high value of resistance to which the oscillator might be connected. If this was in the input to an amplifier, some misleading results could be obtained. The connection of the resistor also prevents the build up of a charge on the output terminal.

SQUARE-WAVE SHAPER DETAILS

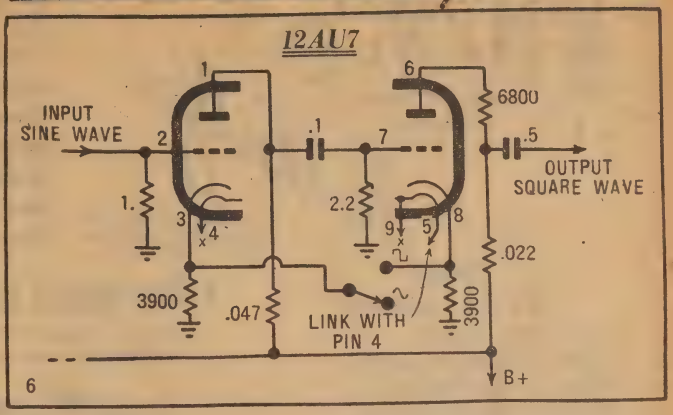

Figure 6: Simple but very effective is this square-wave shaping stage, using regenerative, over-driven twin triodes. The circuit avoids the losses incurred by other arrangements which involve a high-impedance feed to a grid circuit.

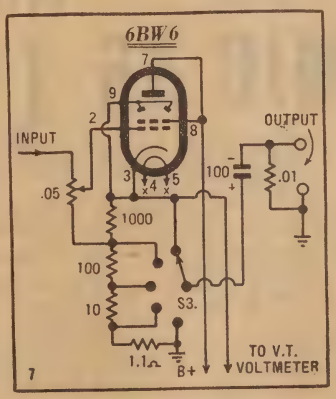

Figure 7: Here are the details of the cathode-follower stage in our new generator, including the fine and coarse attenuators. Maximum output voltage is approximately 10.

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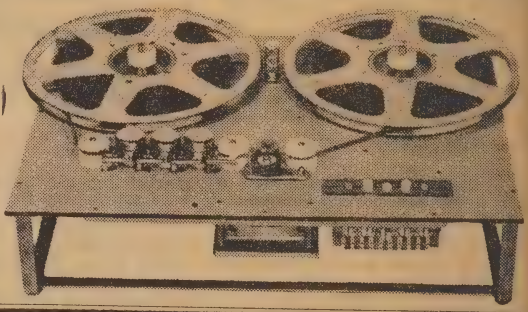

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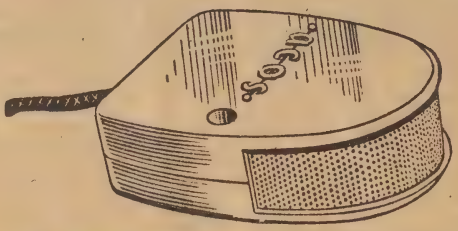

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Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

Frequency response	Substantially flat from 50/5,000 cps.
Output level	= 55 db ref. 1 volt/dyne/cm2.
Load resistance	2 megohms included.
Cable	This microphone is supplied with approximately 4ft. 1.2 metres of co-axial cable (type Unirad 32).
Weight	Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes).
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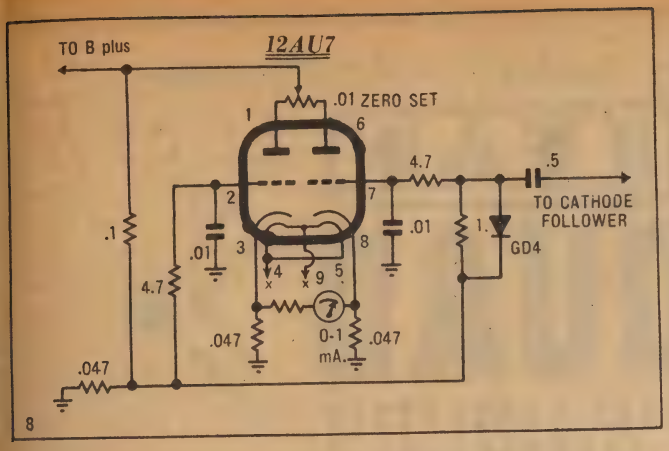

Fig. 8.—Diagram of the balanced triode valve voltmeter used as the output level indicator in the audio oscillator.

The valve voltmeter is of the balanced triode type with the indicating meter connected between the two cathodes. These cathodes have high values of resistance in their circuits to stabilise the circuit.

Because of the positive voltage developed across these it is necessary to connect the grid returns of the two valves to a point which is positive to obtain the desired valve operating conditions. This is accomplished by a voltage divider from B-plus to earth.

The meter used had a fundamental sensitivity of one milliamp and the resistor in series with it is chosen to give the desired full scale deflection.

Zero setting of the meter is achieved by varying the B-plus applied to the valve anodes. As the potential on one is increased, it is reduced on the other and balance at the potentials on the cathodes is obtained.

For rectification of the audio voltage a germanium diode is used. This obviates the need for another valve heater being supplied and its physically small size is of considerable assistance where the space is limited.

As the valve voltmeter is of the peak reading type there would be a variation in the reading when switching from sine to square waves if the RMS values of the two waveforms had been made the same.

However it was thought that it was better to make the peak values of the waves equal. This not only makes the voltmeter readings correct, but also gives the same pattern height when the output of the generator, or the equipment being tested, is being viewed on an oscilloscope.

The power supply in its final form is quite simple and was arrived at after some considerable experiment. It will be seen that the cathode follower is fed from a separate filter section. This is absolutely necessary if ripple voltage is not to be fed back into the earlier stages of the oscillator.

Further, the heavy current drawn by the cathode follower bleeds the filter condensers and reduces the effective filtering. If the same filter condenser is used to feed other

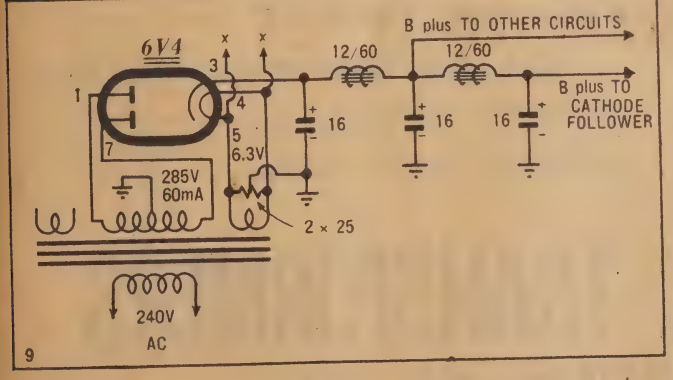

Fig. 9.—The power supply of the oscillator which uses standard receiver type components.

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Please note that this work has had phenomenal sales in the United Kingdom, where the author is highly regarded for his lucid and informed writing. Also, whilst the book covers techniques and equipment for the British systems, it must be pointed-out that our TV is to be based largely on the current British practices. Therefore, with its information on the construction, calibration and uses of TV servicing instruments, this publication will be found to be particularly appropriate to our conditions.

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"Simple ELECTRONIC MUSICAL INSTRUMENTS for the constructor," by Alan Douglas. .. .. Price 7/6.
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arts of the circuit, mains ripple is ntroduced.

The chokes used are of the types vhich are standard with radio upply houses these days. As these ire only of 60 milliamp rating, they ire sufficiently small to be placed nder the chassis.

Most of the electrolytic condensers ised are of the vertical chassis-nounting type to make use of small spaces above the chassis. The use of this "third dimension" makes nder chassis wiring much easier.

Every effort was made in the design to keep the power supply requirements to a minimum to keep the power transfomer size down. The final design has permitted the use of a 285 volt per side, 60 milliamp receiver type.

The rectifier is fed from the same winding as the rest of the oscillator circuit. However, if a second 6.3 volt winding is provided this could be used.

The winding supplying the oscillator needs to be centre-tapped and, in practice, two ½-watt 25-ohm resistors were found to be satisfactory.

In the interests of keeping down chassis hum currents, the transformer used was of the vertical mounting type. For the same reason an aluminium chassis was used.

In the interests of standardisation the same case was used for the oscillator as was used for the Senior Signal Tracer.

This case measures 13in x 8in x 6¾in and the louvres in the side provide adequate ventilation for the oscillator. Four rubber feet on the underside of the case and a carrying handle complete the finish of the case.

The front panel controls were grouped to give ease of control and circuit layout. The dial which has five ranges is some six inches in diameter, and permits reasonable spacing of the calibrations.

Next month, we plan to describe in detail the construction of the audio generator, with a complete circuit diagram and photographs of the wiring. It should prove to be an ideal instrument for those wishing to conduct detailed tests on audio equipment.

The Serviceman Who Tells

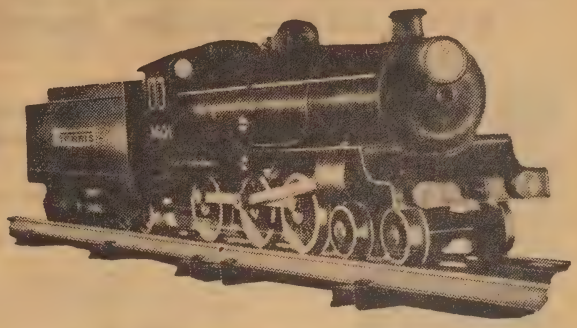
(Continued from Page 47)

usually finds the weak spot in the filament, and thus most lamps fail at the moment of switching on. To reduce this hazard, it is recommended that sufficient resistance be included in the circuit to limit the surge current to about three times the normal running current. This resistance may be shorted out a few seconds after switching on. It is also handy for reducing the voltage to the lamp during adjustments.

I passed these facts on to my friend the projectionist, who was suitably impressed, and is at present trying to work out a scheme which will allow such precautions without making the equipment unduly complex.

But that, I hope, will be another story.

FERRIS Electric TRAINS



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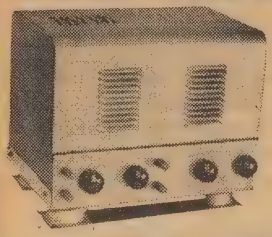

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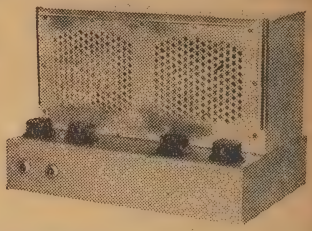

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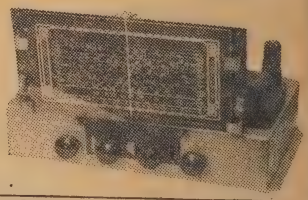

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Here's your answer, Tom!

It appears that Tom has taken to heart what we said about bearded pioneers last month. Mind you, this month's questions are none the less involved, but at least they deal with more contemporary subjects, with which yours truly is somewhat more familiar. In brief, we have pickups, circuits and the evergreen Ohm's Law chalked up for discussion this month.

YOU may have some misgivings about calling Ohm's Law a contemporary subject, the said law being well over one hundred years old.

The fact is, however, that with this law stands or falls most of our electrical theory. Consequently, it is a very modern subject indeed.

One question at a time, though. Let's see, what Tom has to say.

There are many types of pick-ups available today. Crystal, ceramic, magnetic, moving iron, piezoelectric, moving coil, variable reluctance are being advertised, and the prospective buyer has the time of his life trying to select one of them. Could you explain how these devices work and what are their main advantages and disadvantages?

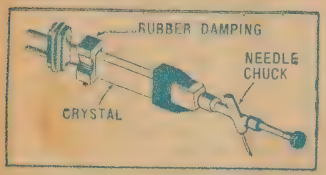


Diagram showing the general construction of crystal pickup.

Before going any further, Tom, we better get a few of our terms clear. You see, the pickup types you mention can be divided into two distinct groups: (1) piezoelectric and (2) magnetic. Crystal and ceramic pickups belong to the first, moving iron, moving coil and variable reluctance types to the second.

The operation of piezoelectric pickups is based on the property of certain crystals to assume an electrical charge when subjected to mechanical stress. The amount of charge depends on the degree of stress applied to the crystal, and its polarity on the direction of the stress.

Now you know, Tom, that the needle in an acoustic gramophone is forced to follow the excursions of a groove. This side-to-side movement is transmitted to the diaphragm which, in turn, initiates corresponding vibrations in the air.

If we were to couple the needle to a small crystal instead of a diaphragm, the stresses placed upon the crystal by the movement of the needle would result in corresponding electrical charges being set up on its surface.

It would be possible to place small metal electrodes on the crystal to pick up these potential differences, which vary with the stress on the crystal, and apply them to an amplifier, driving a loudspeaker. And presto—we have a crystal pickup . . . of a kind.

Needless to say, such a pickup would be far from perfect. To start with, it is of no use glancing toward mum's treasured "crystal" vase as a ready source of crystal for the experiment. Only certain kinds, such as quartz, or Rochelle salt crystals show this effect to any useful degree. Even these have to be ground or cut to a particular shape to be suitable.

In practice, Rochelle salts are used because they are easier to shape and have a very high output as compared with quartz. Two slabs are usually cut from the crystal and cemented together with a thin metal foil between them. Two other foils are attached to the outer faces, connected together electrically. These constitute one electrode, the centre foil the other, and the output is taken from them.

BIMORPH CRYSTAL

This arrangement is known as a "bimorph" crystal assembly and is universally employed for this type of pickup.

One end of the "bimorth" crystal is held fixed within the pickup head, while the other carries some means of attaching to the needle, or as it should be called, the "stylus". Depending on the stylus mounting, sideways movement either bends the crystal, or twists it about its own axis.

The potential difference between the electrodes is then applied across a "load resistor", and thence to the input of an amplifier, which amplifies the minute voltages to the desired level. The loudspeaker converts these amplified signals into acoustical energy.

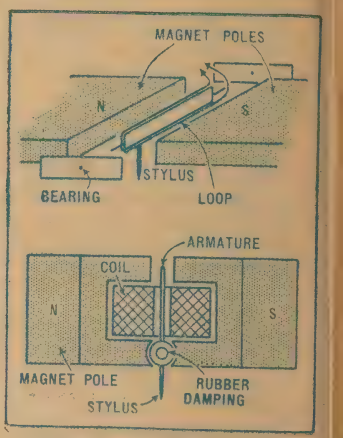
Ceramic pickups work on the same principle, but, instead of the crystal slab, they use ceramic materials consisting largely of barium titanate. These materials also exhibit piezo-electric properties much like Rochelle salt crystals.

Magnetic pickups, the second group, use a much more familiar means of converting the stylus movement into electrical signals. We refer to electromagnetic induction.

Of course, you know, Tom, that if a conductor is moved in a magnetic field, a current is induced in that conductor. In other words, if a moving conductor cuts magnetic lines of force, a current is induced in it.

We could alternatively have a fixed conductor, and alter the number of lines of force across the conductor. This would also induce a current in it. This principle has been utilised in a large variety of pickup types.

Magnetic pickups all have one fea-



Schematic diagram of two types of magnetic pickup: Moving coil on top and moving iron below.

ture in common: they all have a permanent magnet to supply the constant magnetic field. In some old style units this magnet weighed anything up to 1lb or even more. The improvement in magnetic alloys has brought this weight down to usually less than an ounce in present-day designs.

Let us have a look first at tthe moving coil pickup. As already mentioned, we have a magnet with specially shaped pole pieces. Between the pole pieces there is a small, stiff loop of one or more turns of wire suspended in tiny bearings on two ends. A needle chuck or other provision for fixing the stylus, is attached to one side. The whole set-up is very similar to a small meter movement.

Thin, flexible leads are brought out from the ends of the loop to the pickup terminals for connection to the amplifier.

The sideways movement of the stylus turns the loop through a small arc and, in the process, the lines of force of the magnet are cut by the loop. The small current thus obtained can be amplified in the conventional manner.

Other types, called "moving iron" pickups have both the magnet and the coil fixed. The magnet structure takes the shape of an U, the coil or loop being placed in the gap. A small piece of soft iron goes through the loop, so that its ends come near but do not touch the poles of the magnet. One end carries the needle or stylus attachment. Movement of the needle alters the spacing between the iron reed and the pole tips, thus varying the flux, or number of lines of force through the coil, and inducing a current in it.

MAGNETOSTRICTION

Still another method to obtain a variation in flux is one based on the principles of magnetostriction. Certain ferromagnetic alloys under tension change their reluctance (resistance to magnetic flux) if the tension is increased or decreased.

In variable reluctance pickups the gap between the poles of the magnet is bridged by a thin ferromagnetic wire, twisted 90 degrees to keep it under tension. The stylus is attached halfway between the poles. The coil is split in two halves and fixed around the two ends of the bridge. Any flexing of the bridge by the stylus movement results in increase or decrease in tension and a corresponding decrease or increase in reluctance.

The corresponding change in flux induces a signal current in the coil.

The preceding paragraphs give a general idea of how the mechanical movement of a stylus or needle is converted into an electrical signal. However there are many considerations, which govern performance.

One of these is the output signal from the pickup. Crystal and ceramic units normally have a fairly high peak output, generally of the order of .25 to 3 volts. Modern magnetic types on the other hand very rarely exceed 0.25 volt output. With any particular type, an amplifier of suitable sensitivity would have to be used.

PROPORTIONAL

The output voltage from a piezoelectric pickup is proportional to the stress applied. The larger the amplitude of the groove swing, the larger the output voltage. For this reason such pickups are usually said to be "amplitude conscious".

Magnetic types on the other hand are "velocity conscious". Their output voltage depends on the number of lines of force cut per second. Obviously this occurs at a much higher rate at the higher frequencies than on the lower frequencies, where the speed of the stylus is comparatively low.

Another criterion of performance is the ability of pickup to generate the same order of signal for all frequencies recorded at the same level. In other words it should have substantially the same output a 100 c/s as at 1000 c/s, or any other frequency. If such is the case, the pickup is said to be "flat" in its response. However, only a few types attain this objective.

Most types, particularly of the not-so-expensive variety exhibit peaks in their output at certain frequencies. The main reason for this is mechanical resonance of the needle, stylus mounting or moving parts of the pickup at certain frequencies. To minimise these peaks moving parts are kept as small as possible consistent with rigidity. Most pickup mechanisms are also mounted in rubber or suchlike with a special jelly to damp out the resonance.

SMALL PARTS

It is relatively simple to reduce dimensions in a magnetic pickup, as the moving parts, generally called the armature, are not directly linked with the part supplying the output—the coil. However in crystal pickups the crystal has to be solidly connected to the armature and its mass is added to the moving parts. They are thus more likely to exhibit peaks within the audible range.

Nevertheless, it is possible to "flatten" the response of many such pickups by altering the load resistance, and connecting compensating networks between pickup and amplifier.

However small the stylus is, it is subjected to forces 1000 times the force of gravity during tracking the groove. If there isn't sufficient compliance between the stylus and the pickup head, heavily-recorded parts of the groove will throw the pickup off, often damaging the record. Compliance in the horizontal direction is therefore very important.

As the record is cut with a flat stylus, the groove width is not constant. It is narrowest at the peaks. The stylus or needle being conical in shape, it will tend to lift out from the narrower groove. There must be sufficient vertical compliance in the pickup to counter this effect, although it must not generate a signal by any verical movement.

NOT CHEAP

As you see, Tom, there is a lot more in those tiny gadgets, than meets the eye. No one particular pickup can have all the desirable features, although some get very close to being perfect. Which one

(Continued on Page 119)

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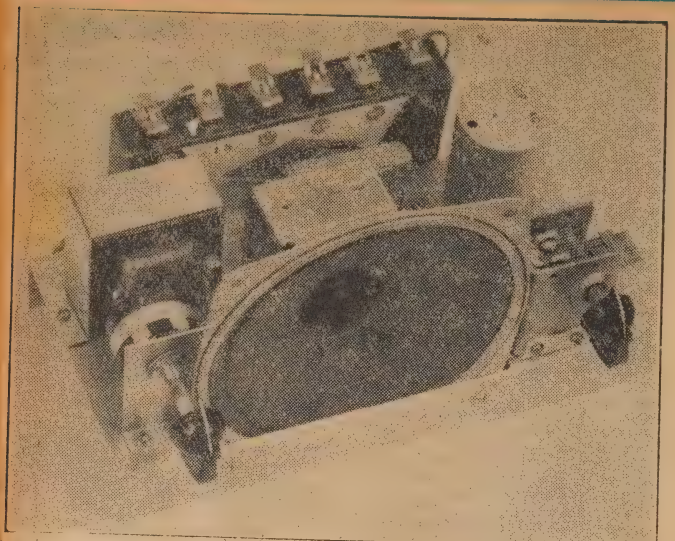


Front view of our latest experimental transistor set, built up for a change on a simple metal chassis. The output transformer may be seen on the extreme left of the chassis, while the class-B driver transformer is just visible behind the speaker. The tuning capacitor and coil are on the right.

USING TRANSISTORS IN CLASS-B

One of the most interesting transistor applications, which we have not thus far studied, is their use in class-B output stages. Higher power output is available than from class-A operation and even greater economy in battery drain. This article explains how you can add a class-B output stage to your experimental transistor set.

by W. N. Williams

RIGHT at the outset it may be wise to explain what is meant by the erms "class A" and "class B" and ee how their significance is carried ver from valve to transistor prac-ice.

The conventional method of oper-ting a valve as an amplifier is de-ned as "class A" operation, for vhich purpose the grid bias is set pproximately halfway between zero nd the value necessary to produce late current cut-off. The plate cur-ent which flows under these cir-umstances is often referred to as he "standing" current.

GRID SWING

On the application of a signal the rid swings above and below its itial bias, but for class A operation should never swing positive nor eyond cut-off. The plate current is ssumed to vary in linear fashion at le signal frequency, but its average alue, as read on a meter, remains ubstantially at the "standing" cur-ent figure.

In other words, a class A amplifier raws the same high tension current, hether or not it is handling an input gnal. The total input power is qual to the product of plate cur-nt and plate voltage, and since a class A amplifier is never more than about 30 pc efficient the power out-put cannot be more than about one-third the power input.

This fact led to real difficulties in early battery receivers, because a good deal of audio drive was re-quired to produce worthwhile acous-tic output from loudspeakers of the day. Since three times as much DC power had to be fed into the plate of the output valve as ever came out of it in the form of audio power the problem of battery drain was quite an urgent one.

Hence the question . . . was it pos-sible to devise some kind of an out-put stage which would deliver more power output for less power input? A more efficient stage, in other words.

Class B operation offered a solu-tion to the problem.

A valve operating under class B conditions is biased initially close to cut-off so that its standing plate current is very low. When an input signal is applied to the grid the nega-tive-going half-cycles carry the grid well beyond cut-off, so that plate current does not flow at all during this portion of the input cycle.

On the positive-going portion of each input cycle the grid is swung up toward zero bias and, possibly, right into the positive bias region.

Naturally, each positive excursion of the grid produces a sharp rise in plate current and, since it is not counterbalanced by a dip in plate current during negative excursions, the average plate current of a class B amplifier tends to increase when it is handling signals.

Thus, when the stage is idle, it draws very little current. When low-level signals are applied it draws a little more current; on high-level signals it draws a lot of current and delivers a lot of output power.

PUSH-PULL ACTION

However, the output wave is dis-torted because only the positive-going half of the input signal is re-produced, the negative half being largely lost. To offset this effect class-B amplifiers in audio service must be used in push-pull, each valve supplying the half of the signal which its opposite number misses out on.

The two distorted waveforms are added in the push-pull output trans-former to produce a non-distorted drive to the loudspeaker voice coil.

Another point about class B opera-tion is that driving the grids positive means that they draw current and impose a load on the preceding amplifier. In practice the preceding amplifier has itself to supply a cer-tain amount of audio driving power, being coupled to the push-pull class-B grids by means of a low-resistance push-pull transformer.

Inevitably, therefore, a class-B stage is somewhat complicated, but it has the advantage of being able to deliver far more peak power than is available from comparable valves under class-A conditions. And it does so very economically, too.

VARIES WITH SIGNAL

In an ordinary room the general level of output from a receiver is quite low, rising to occasional peaks of voice and music. When a class-B output stage is used the current drain follows a similar pattern. The over-all economy is much better than when using a comparable class-A stage, which draws full current all the time,

:her or not it is handling a signal.
ass-B dropped out of favor in
ery sets when more sensitive
kers were produced, allowing
gh power to be obtained, with
onable economy, from small
-A output pentodes. It was a
of circuit economy outweighing
ery drain.

ie arrival of transistors has
ied up the whole subject again,
reasons which are not entirely
llel to the valve case.

the first place the power which
be dissipated in a power trans-
r is severely limited, ranging in
cal cases from about 45 to 200
watts. If this amount of power
ed into a transistor under what
might call "class-A" conditions
more than about 40 pc of it can
recovered as audio power to the
speaker.

owever, by using two transistors
push-pull, twice the input and
e the output can be expected.
that is not the end of it. By
nging that the transistors draw
little standing current — just
a class B stage—the dissipation
be kept well within limits, even
wing for extra current on signal
ks.

IMATE ECONOMY

nen there is the matter of battery
n. Transistors are a lot more
nomical than valves, anyway, but
temptation to pursue economy to
imits is a strong one. By using
ass B output stage in a portable
plenty of audio power can be
liable, yet the whole set will run
cheaply from a small battery.

me calculations recently made
Australian conditions suggest that
operating cost of a typical small
able receiver is about 1.9 pence
hour.

y designing for a similar perform-
e using transistors and a class-A
ut stage operating cost would
to about one penny per hour
substituting a class-B output
e and generally going after eco-
y the operating cost could be
ced to 0.16 pence per hour,
ch is little more than the oper-
g cost of a mantel receiver run-
from the power mains.

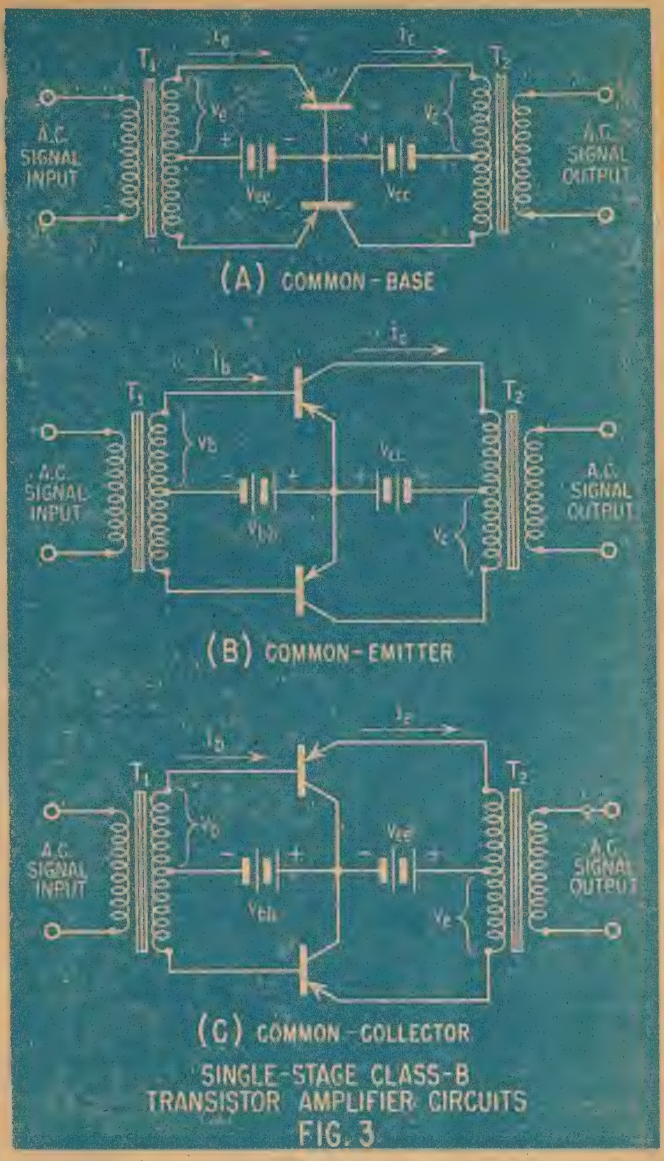
uch a figure immediately suggests
possibility of a battery-operated
sistor set which would serve
ally well as a picnic portable or
antel set around the home.

here is no indication at this stage,
ever, which of the two general
ngements commercial set design-
will prefer—class B, with its
nomy and complexity, or class-A,
its circuit simplicity but high
ery drain. Either way it is a good
g to know something about class-
peration of transistors, even if
because it features so large in
application notes.

NSISTOR TERMS

the light of what has been
in foregoing issues, it must
bvious that the terms class-A
class-B are not identical with
e usage, when applied to tran-
rs.

hief point of difference centres
he fact that, in a class-A valve
e, the grid never goes positive
never draws current from the
al source. In the case of a tran-
r, the input electrode always



SINGLE-STAGE CLASS-B TRANSISTOR AMPLIFIER CIRCUITS
FIG. 3

Reproduced by courtesy of "The Aerovox Research Worker," this diagram illustrates the three-circuit configurations possible with a class-B stage. Input/output curves for two of these configurations are reproduced overleaf.

draws current and this distinction between the two modes of operation disappears.

The significance of the terms is, therefore, restricted to the balance between the emitter bias and the collector current.

For "class-A" operation, the bias is set so that the collector current falls at some intermediate value along the transistor's input-output curve. The resultant "standing" collector current most obviously meet battery drain requirements and be within the ratings of the particular transistor.

On the application of a signal to the base or emitter, the collector current will vary at the signal frequency, but, assuming that the variations up and down are of equal amplitude, the average current as read on a meter will remain the same. This is exactly parallel to the behavior of the plate current in a class-A valve amplifier.

For class-B operation of transistors, normal practice is to set the

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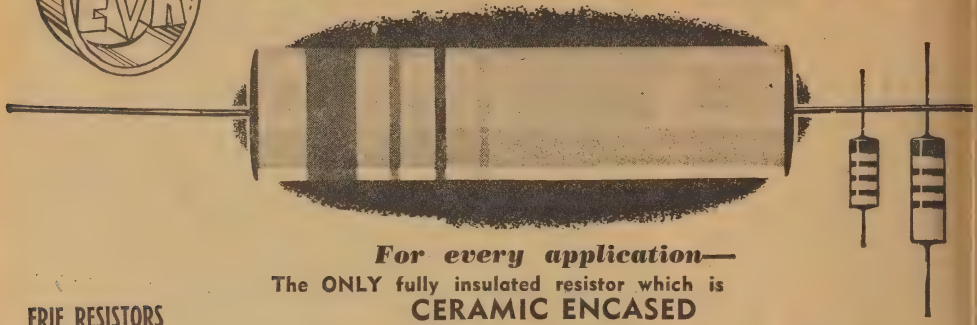

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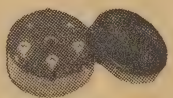

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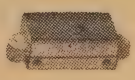

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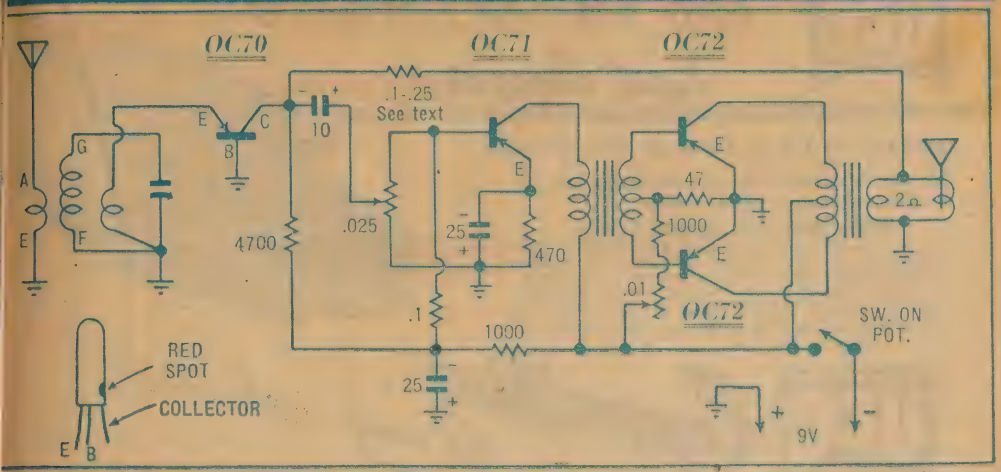
TRANSISTOR SET WITH CLASS-B OUTPUT STAGE



Our experimental transistor set is growing up! A class-B output system ensures more power output than is available from a conventional battery portable and at only a fraction of the battery power. The RF end is still quite primitive, however, and awaits further development.

nitter bias so that the collector urrent is very close to cut-off. Wi'h n input signal applied, one half he input cycle produces a complete ulse of collector current, while the ther half simply carries the collec- r current to complete cut-off.

To avoid serious consequent dis- ortion, it is essential to use two ransistors in push-pull, exactly as ith class-B valves, so that their urrent excursions will add in the utput transformer and produce a on-distorted output signal.

In a recent issue of the "Aerovox tesearch Worker", the authors point ut that there are actually two ways f operating transistors in class-B ervice. One, as already discussed, nvolves applying a fairly high volt- ge to the collector but operating ith low collector current. This orresponds with point "Y" on their igures 1 and 2, which are repro- luced herewith.

The alternative is to set the initial operating point so that the collectors draw high current but at a low applied voltage, corresponding to points "X" on the same two diagrams. On the application of signal, the collectors alternatively swing down toward cut-off, their current excursions adding in the output transformer to produce a non-distorted output signal.

Though still described as "class-B" operation and interesting from the theoretical viewpoint, this particular arrangement is a less practical one, because it generally involves high standing current from the batteries and large IR loss across series resistors.

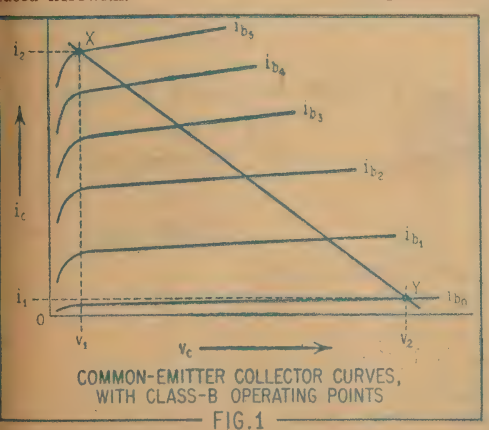
Again, class-B operation is possible with any of the three well-known circuit configuration, common-base, common emitter, or common collector. The alternative arrangements are shown in figure 3.

The output circuit efficiency is claimed to approximate 80 pc in each case.

Power gain is highest in the case of common emitter, somewhat lower for common base and quite low for common collector. While common base operation actually offers the best overall performance for any given distortion level, the common emitter circuit is generally preferred because of its higher gain and the fact that collector supply and bias can be derived from the one battery.

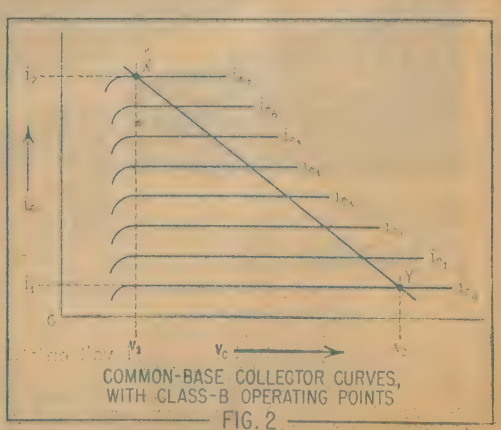
So much for the theory. When it came to getting a class-B output stage into operation, we had to do it the hard way, finding out a good many things by trial and error.

We still had on hand the "mate" of the OC72 junction transistor which we used last month in a single-ended class-A output stage. Since this latter had not been



COMMON-EMITTER COLLECTOR CURVES, WITH CLASS-B OPERATING POINTS

FIG. 1



COMMON-BASE COLLECTOR CURVES, WITH CLASS-B OPERATING POINTS

FIG. 2

These curves illustrate "class-B" operating points for common-emitter and common-base class-B circuits. Points "X" indicate low-voltage high-current condition, while points "Y" indicate the more usual high-voltage low-current condition.

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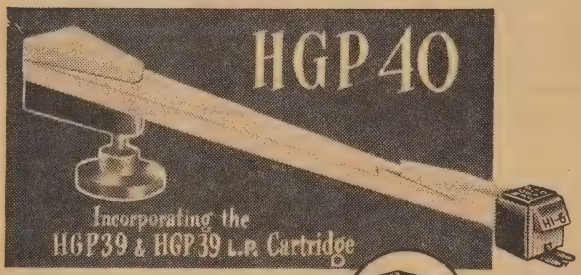

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ised in any way, we had reason-
e hopes that it would still match
unused one.

At present, transistors are not suf-
ently uniform from one sample
the next to be certain that any
o of them will make a good pair
class-B service. Quite obvi-
sly, unequal characteristics in
ss-B will mean unequal amplifi-
ies on the two halves of the out-
t signal and therefore increased
tortion.

While the matched pair is there
e desirable, readers who have
eady bought a single one may
ve no choice but to make it with
other odd one and hope for the
st. It will not be a question of
rking or not working, but rather
e of optimum results.

BLISHED DATA

A limited amount of data has
en published on class-B operation
the OC72 and this naturally
oved to be of considerable assis-
nce. It indicated, for example,
at an OC71 could be used as a
iver for a pair of class-B OC72's
d gave a certain amount of de-
gn data on a suitable driving
ansformer.

Wound on a core measuring 31
25 x 8 mm., the transformer has
00 turns on the primary and 600
rns on each of two secondaries,
filar wound. The turns ratio is
erefore 3.5:1 primary to half-
condary, which is a considerably
eater step-down than is available
om any ordinary B-class trans-
rmer intended for valve opera-
on.

When we tried to get such a trans-
rmer wound up, the immediate
oblem was to find a standard
re small enough for the job, since
is considerably smaller than any-
ing normally used in conventional
dio sets.

Finally we did manage to get a
uple of experimental transformers
ade up, which allowed us to get
with the job. One of these was
very small unit measuring 1 x $\frac{3}{4}$
5-16in, on a mu-metal core,
aving an inductance (according to
e manufacturer) comparable with
e original type.

ARGER CORES

The other two transformers were
larger laminations, about the
ze currently used for the smallest
vailable speaker transformers.
ne was wound with a bifilar
econdary, while the other had a
mple 1200-turn secondary tapped
the centre.

We tested each of the transfor-
ers in turn and found that they all
orked well. If anything, the baby
u-metal job had a slight advant-
ge, even though it too had only a
mple, tapped secondary.

The difference between the other
wo transformers on larger, con-
entional grade cores was micro-
copic and rather led us to the as-
umption that the bifilar winding
as an unnecessary complication in
ractice.

Cost and size would determine
hether this kind of transformer
ould be preferred to the more
ostly nu-metal core for a miniature
ype. Certainly, the larger core
oks somewhat ungainly on a tran-
istor set, even though it is quite
mall by valve standards.

What we did find, however, was
n obvious difference in perfor-
mance with the polarity of connection. In each case, results were markedly better with either primary or secondary connected a particular way round into circuit.

We could only put this down to some mismatch in the input impedance to the output transistors, which became obvious as the transistors were driven hard into signal peaks. One way, the disparity added to non-linearity in the OC71 driver; the other way it apparently cancelled.

Our next big problem had to do with the output transformer and load. The same data as mentioned previously implied the use of a transformer about the size normally supplied with a small speaker but, while turns ratio was quoted, it gave no hint as to the most suitable collector-to-collector load.

Since an operating voltage of 6 was mentioned and a posible power output of 250 milliwatts, it was possible to work backwards in terms of likely peak voltages and power to derive a load of about 350 ohms, collector to collector.

We managed to get a couple of transformers made up to these specifications. One was about the size of the larger driver transformer already mentioned and, while ordinary enough in its characteristics, wasn't quite as efficient as we would have liked in terms of power transfer.

The second transformer, which actually appears on our experimental chassis was a larger affair, for which an efficiency of 90 pc was claimed. It certainly seemed to live up to this claim, though it is rather unwieldy in terms of size and weight.

CLASS-B AND HOW!

Once having got our class-B stage into operation we began to see our earlier remarks about varying collector current coming very true. From a standing current of about 2 milliamps, the meter would swing over to 50 milliamps quite easily on peaks of signal.

For all that, however, we could not get the expected 250 milliwatts with a 6-volt supply. What about 7.5 volts, 9-volts, 13.5 volts?

While trying these voltages, we had our first experience of transistors "running away". With 13.5 volts applied and very low standing current, everything looked as happy as it had been on a previous occasion with this voltage applied.

Then we pumped some signal into the stage. Over went the output meter and up went the col-

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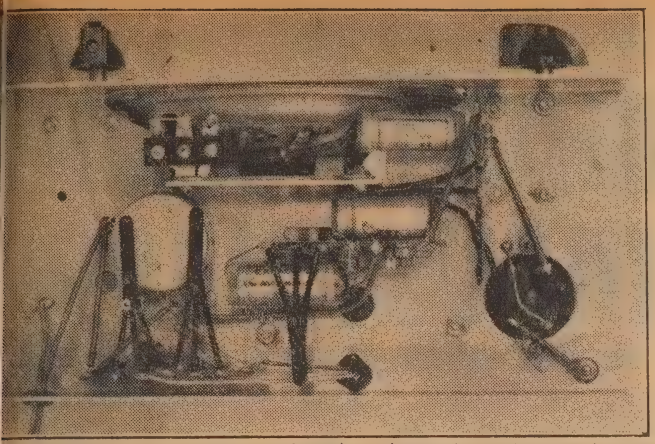

n underside view of the transistor experimental set, showing the transistors wired to tag-ips. The negative feedback was not wired into circuit when this photograph was taken.

ctor current meter—but it kept ing up, faster and faster! We abbed for the switch and walked way, hoping that the transistors ould cool down and become nor-al again.

The rest of our tests were con-ucted on 6-volts, wtih occasional ecks on 9-volts, where the transis-rs did seem quite happy. At this gure, we were able to measure out 370 milliwatts at the second-y of the output transformer, which a good deal better than is avail-le from a conventional battery rtable.

The complete circuit diagram gives ost of the other information you ill need to build a duplicate of e original experimental set.

We stress the word "experimental", ecause we are not presenting this s a set that anyone would want build purely for entertainment. Its rime purpose is to illustrate, in a ractical kind of way, the applica-on of currently available transistors.

The detector circuit is essentially e same as described last month, ith a 25-turn tertiary winding add-d to a high-gain aerial coil. With e can in position, the coupling this winding is somewhat re-uced and a few extra turns may e found helpful in many cases. oupling is also aided by having e internal slug screwed partly into e tertiary winding.

The second transistor now couples irectly into the primary of the lass-B driver transformer and the perating conditions have been aried to suit.

We show a 25,000-ohm potentio-neter, because one was available ith a built-in off-on switch. The 0,000-ohm pot. previously stipu-ated could be retained if a separ-te off-on switch is added and the .1 meg. resistor to HT-minus re-uced to about 80,000 ohms. A tanding current of just under 2 illiamps is about right for this tage.

Standing current is an important eature of the class-B stage and ust be set with the aid of a milli-mp meter. Begin by connecting the neter in series, with the lead to the utput transformer centre-tap, the 0,000-ohm bias adjust pot. being set maximum resistance.

Switch on and, with the volume t zero, bring the standing current up to about 2 milliamps. If the set is now operative, switch the meter over to the 50-milliamp range, turn up the volume and see how the current peaks up with input signal.

Keep your eye on the meter for a while and make sure that the standing current does not begin to creep progressively upward. Actually, it shouldn't do so because the dissipation will be well below ratings.

If you can afford some slight reduction in gain, we suggest that you add the negative feedback circuit shown between the output transformer secondary and the collector of the OC70.

The connections to the secondary will have to be determined experimentally to produce a drop in gain when the feedback is connected.

Physically, the set was built up on a simple folded chassis, measuring 8in x 4in x 1½in. The photographs will show the general layout adopted, although it is not at all critical. In this form, the set is obviously neater than when spread over a piece of plywood.

Although output is higher, the gain is somewhat lower than last month's class-A version and a most outdoor aerial is desirable for best results. An earth is essential, of course.

Your main problem, as a private individual, will be to get hold of suitable transformers. We have the matter under discussion with transformer manufacturers, however, and something may be available as a standard line very shortly.

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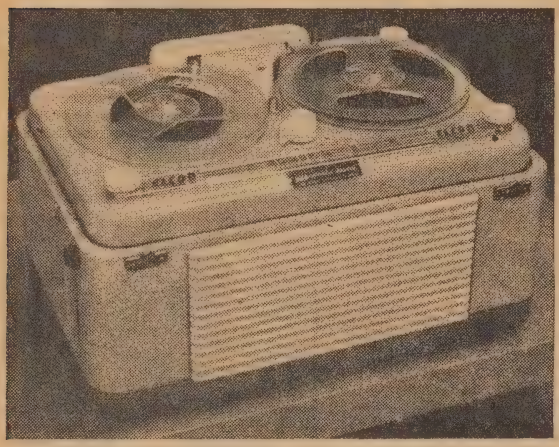

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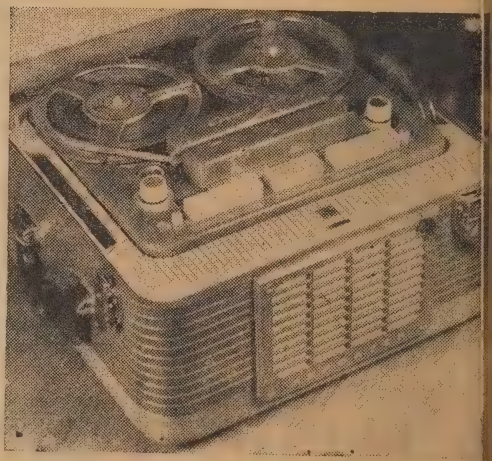

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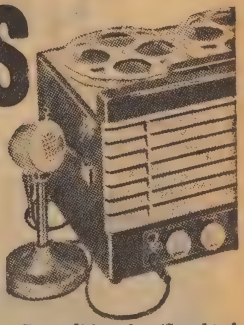

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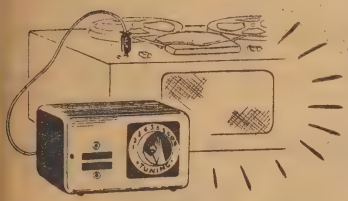

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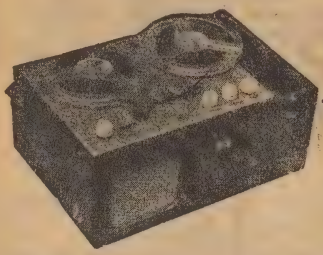

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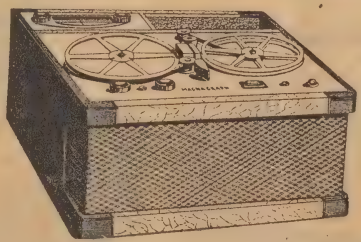

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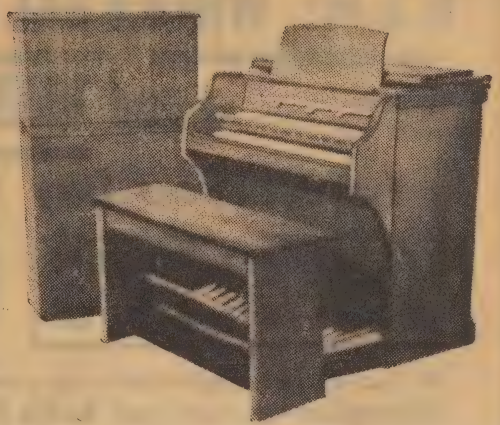
YOU WANT TO BUILD AN ORGAN?

**: it possible to build an electronic instrument
the home? How much skill is required and
hat will it cost? What is the best type to
ttempt—reed, tone-wheel or valve oscillator?
he writer sets out to answer these and other
similar questions.**



The Minshall model E two-manual electric organ—the kind of instrument most home builders hope one day to own. Given enough time, patience and money, an organ like this can be built in the home.

by R. A. B. Tarrant

ERE is a surprising interest in the subject of electronic music Australia and New Zealand and, nly because of the enthusiasm nced following publication of "A vey of electronic music" in this gazine (May, June issues, 1955), author is constrained to offer e homely advice, and to give some d facts on the building of an elec- nic organ.

t seems that would-be builders all nt an organ in their home, and just a little monophonic key- rd attachment for their piano. If h an instrument is indeed desired, s only being built as the first stage making a larger instrument cap- e of playing chords, with a prime w to "seeing how it goes". In t, any potential organ builder is ongly advised to build one of these st.

PROPER ORGAN

Because of this general tendency, is article has been written on the sumption that the home construc- wants an organ—of at least one nual of 61 keys, and at least 12 dal notes.

Strangely enough, apart from a mparatively low percentage of ex- expense, it is not too difficult a b to make a two manual (great and ell) console and a 30 or 32-note dal set while the constructor is at

However, let us start at the begin- ng with the question, "What sort of electric organ will I build?"

The answer is, "Take your pick om dozens!"

In the first instance, the require- ents of an organ builder are three- ld, viz.:

Knowledge — Money — Time.

With regard to knowledge, this is he whole basis of the enterprise al- ough, surprisingly, not VERY uch is required—just the ability to ead a circuit, understand the circuit eing used, the ability to wire well -very well—and, by and large, to ave that "feeling" that comes only fter having built up radio gear as hobby.

NOW YOUR CIRCUITS

This feeling is one of confidence, f not being bluffed by what looks ke a horribly complicated circuit; feeling of being at home with a oldering iron; the self-confidence nat comes from experience in build- ng radio sets and amplifiers and aving tasted of success in past radio ork.

Knowledge of audio amplifier echniques is the sort needed; if you ave built up several of the amplifier ircuits featured in this magazine in he past, have made a workmanlike job of them and know how and why they work, then you are on the right foot for this novel enterprise of building what can be a beautiful and completely satisfying musical instrument.

Now, let us look at the dozens of types of organ you can build. (The "dozens" does not mean radically different types but, rather, dozens of variations on several distinct types.)

Glancing back at Part 2 of the author's article (in June issue of R. T. and H.) you will see that the following classes of organ were mentioned, the names of the most prominent commercial instruments being added in parenthesis.

1. **Electromagnetic generation** of tones (Hammond Electric Organ).

2. **Electrostatic generation** of tones (Wurlitzer Electronic Organ, Minshall Estey Organ, Compton Electrone).

3. **Photo electric generation** of tones (Welte Phototone, Baldwin Photo-electric Organ).

4. **Neon tube generation** of tones. (No commercial instruments in current production.)

5. **Vacuum tube** generation of tones. (Numerous commercial products — some named in the abovementioned previous article.)

Bearing in mind the writer's statement of your requirements—Knowledge—Money—Time — let us now examine the practicability of home construction of these various classes, firstly the electromagnetic.

Forget the Robb Wave and Mastersonic—they're both completely unsuitable for copying by the amateur.

However, there are many copies of the Hammond Organ in existence. Several most pleasing organs of this type have been seen by the writer, and it is interesting to see how the builders have gone about the job. In the first place, nearly all these organs have been a direct copy of the Hammond instrument — involving gear cutting (anything up to 100 gears).

As is well known, this type of organ generates its tones from soft iron discs spinning in front of an electro-magnet assembly. The bumps on the periphery of each disc induce an EMF into the winding around the magnet, the frequency depending on how many bumps pass the pole piece in a second.

In the Hammond Organ this is achieved by dozens of gear wheels, beautifully machined and incorporated into a robust generator unit which is a difficult thing to copy.

DRIVE SYSTEMS

The home builder has two alternatives however and, truth to tell, in some respects, more efficient alternatives, at that.

The first is a belt and pulley system, driven from a centrally-located shaft by a constant speed AC operated motor, which is steadied by a heavy spring-loaded fly-wheel. Along the main shaft are 12 pulleys which are coupled by 12, endless, square-section rubber belts to 12 generator shafts — the size of the driving pulleys being graded so that each driven shaft is faster than its predecessor by 12 times root two, thus ensuring a correct mathematical ratio in observance of the requirements of the musical scale.

Each of these driven shafts is fitted with seven tone wheels, having 2, 4, 8, 16, 32, 64 and 128 high points on their periphery. These tone wheels rotate, edge on, close to the point of the magnet around which is wound the pick-up coil.

This method is, by far, the easiest for the imitator of the Hammond

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K.C.2	R.F.	—
K.C.3	OSC.	6J8GA
K.C.4	OSC.	6BE6
K.C.5	OSC.	ECH33, 1R5, 6AE8
K.C.6	OSC.	6AN7
K.C.7	OSC.	6A8G, 1C7, 1A7CT
K.C.8	OSC.	Autodyne 175 kCs
K.C.9	Reinartz	
K.C.10	R.F. plus Reaction	
K.C.11	B.F.O. 455kCs	
K.C.12	Wave Trap 455 kCs	
K.C.14	Unsh. High Gain, High Impedance Aerial Coil with Top Coupling.	

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K.C.20	R.F.	—
K.C.21	OSC.	ECH33, 6AE8, 1R5
K.C.22	OSC.	6A8G, 1A7, 1C6
K.C.23	OSC.	6J8GA
K.C.24	OSC.	6BE6
K.C.25	OSC.	6AN7
K.C.32	Unsh. Aerial	
K.C.33	Unsh. Oscillator	

S/W COILS

K.S.C.1	Aerial 16-50M
K.S.C.2	R.F. 16-50M
K.S.C.3	Oscillator 16-50M
K.S.C.4	Aerial 13-42M
K.S.C.5	R.F. 13-42M
K.S.C.6	Oscillator 13-42M

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K.I.F.2	175kCs No. 1 Autodyne
K.I.F.3 & 4	455kCs No. 1 & 2 High Gain
K.I.F.5 & 6	455kCs No. 1 & 2 Std. Gain
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K.U.3-6	Aer. & Osc.	6A8G, 1A7, 1C6
K.U.3-7	Aer. & Osc.	1R5
K.U.3-8	Aer. & Osc.	6J8GA
K.U.4-3	Aer. R.F. Osc.	6BE6
K.U.4-4	Aer. R.F. Osc.	ECH33, 6AE8, 6K8
K.U.4-5	Aer. R.F. Osc.	6AN7
K.U.4-6	Aer. R.F. Osc.	6A8G, 1A7, 1C6
K.U.4-7	Aer. R.F. Osc.	1R5
K.U.4-8	Aer. R.F. Osc.	

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rgan, and is not as complicated as may appear.

The equipment needed is access a 2½in screw cutting lathe, a nall milling machine, a press, metal orking tools and a fair bit of patience.

That is the mechanical part. The ectrical and electronic work involved are not complicated features an electro magnetic organ of this pe. However, for tonal reproduction, a 20 watt amplifier, with cent on good bass response, is lled for.

The other method of driving the ne wheels at the correct speeds is ss complicated and may be better ited to the home builder. This is gearing, calling for a gear train 24 fibre (or similar composition) ars, ¼in face, pitch 48, 12 with 196 eth and 12 with 185 teeth.

ASIC SCHEME

The scheme is this. All C generors are mounted on the one shaft hich is made to rotate at 16.351 volutions per second. On this shaft e the above mentioned tone wheels ving us, therefore, the lowest C for e organ of 32.702 cycles per second, .406, 130.812, 261.624 and so on. ote that all C notes are in perfect tave relationship (as with the belt d pulley drive).

Now, on the C shaft is a 196 toothl gear wheel. This drives a 185 othed wheel on the C sharp spindle a speed increase, to the latter, of times root two. At the lowest note, is results in an error from the rue" frequency, of only—0.13 of e cycle per second. In turn, a 196 ar on the C sharp spindle drives a 5 tooth gear on the D shaft, and on.

However, beware! Whilst this sysm is simple in theory, the mechics are not since you will enunter problems of backlash, causg unbelievable squeaks, thuds and ating sounds in the speaker. This nfortunate position can be somehat remedied by spring-loading the iving and driven gear wheels, and urnalling the bearings with great re.

(In such an experimental gear ain, built many years back, the thor had the gears immersed in AE 50 oil as a means of steadying e backlash: it was a messy busiss!)

From our experience the belt ive system is by far the best, though it calls for patience to hieve the mathematical accuracy the abovedescribed gear drive.

LECTROSTATIC

Turning to the electrostatic system tone generation, we come to the oroughly explored field of vibratg reeds. (A discussion on copying e Compton Electrone would achieve thing, being completely beyond e abilities of the amateur builder).

The principle of electronic treatent of a vibrating reed is simplicity itself and is by far the most pular method of tone generation ith home constructors.

However, there are many heartaks in store for the builder who pects string tones and strident umpet tones for, in fact, the exaction of much else than flutee qualities from a reed is a job lling for much care and experient and an above normal quota patience.

The system of extracting the tone is easy. It embodies the placing of a tone pick-up member, charged with several hundred volts DC very close to, but not touching, a vibrating reed, such as is found in a mouth organ or American organ or harmonium. The output from the positively charged tone pick-up is fed, through a condenser, to a pre-amplifier.

Let it be said that there is absolutely no suggestion of "reediness" about this resultant tone: to the contrary it has, particularly in the middle registers,, a very pleasing mellow and flute-like sound, and you would never guess, for one second, that such a tonal quality was derived from a vibrating brass or steel reed.

The most satisfactory commercial product based on this principle is the Wurlitzer Electronic Organ.

SOUNDPROOF BOXES

In the Wurlitzer, all the reeds are encased in metal soundproof boxes, are of a special type adapted for the purpose, are individually treated and voiced by craftsmen and have been the subject of intensive research.

Frankly, while you will derive much satisfaction from a reed-type of electronic organ, you cannot hope to get very far with the reeds available from old harmoniums and American organs, although they will provide a very satisfactory basis with which to experiment.

The major problems with this kind of instrument are as follows:—

Finding a type of reed which will generate a plurality of harmonics of sufficient level to enable one to use several tone screws per reed. In the earlier commercial models, tone pick-up screws were set, side by side, along the length of the reed in order that various harmonics, appearing on different portions of the vibrating member, might be picked up and dealt with.

With the average reed, obtained from an old "pedal organ", very little difference in tone will be noticed for varying placings of the pick-up screw. To achieve this required variety, specially designed and skilfully voiced reeds (as used in the Minshall-Estey electronic organ, now out of production) are necessary.

The current Wurlitzer models, which the writer has heard, are beautiful instruments—although somewhat lacking, in his opinion, with regard to a "brilliant" treble—and employ but two pick-up screws per reed, as a general rule. However, certain models also have another pick-up device in addition to the pick-ups over the length of the reed; this is a "trumpet" pick-up which is a bent piece of sheet metal placed as per the diagram overleaf.

ADDITIVE SYNTHESIS

It is interesting to note that the Rudolf Wurlitzer Company now employ a certain measure of additive synthesis (see "R.T. and H.," May, 1955, p. 53), and the amateur builder is well advised to experiment with this, borrowing octaves and fifths from reeds higher in the scale than that being treated.

Apart from the tone coloring of brass reeds—or, rather, lack of it—it is in the lower bass notes and the higher octaves that you will become dissatisfied. The low notes, whilst definitely exhibiting a recognisable "pitch", tend to sound muffled and "woolly", and lack body and character. On the other hand, the high notes tend to sound the same—not in regard to pitch, but in tonal quality, and are definitely colorless.

Of course, it will be argued, so do the top notes of any organ sound alike, there being quite a similitude in tone between, say, the top octave of flute 8ft and open diapason 8ft. Virtually the only difference is one of scale.

We can class the muffling of the sound of the vibrating reeds as a mechanical problem, and this is important. In the Everett Orgatron, the first full-scale commercial instrument of this type (1934), the organ was marred, to no small extent, I

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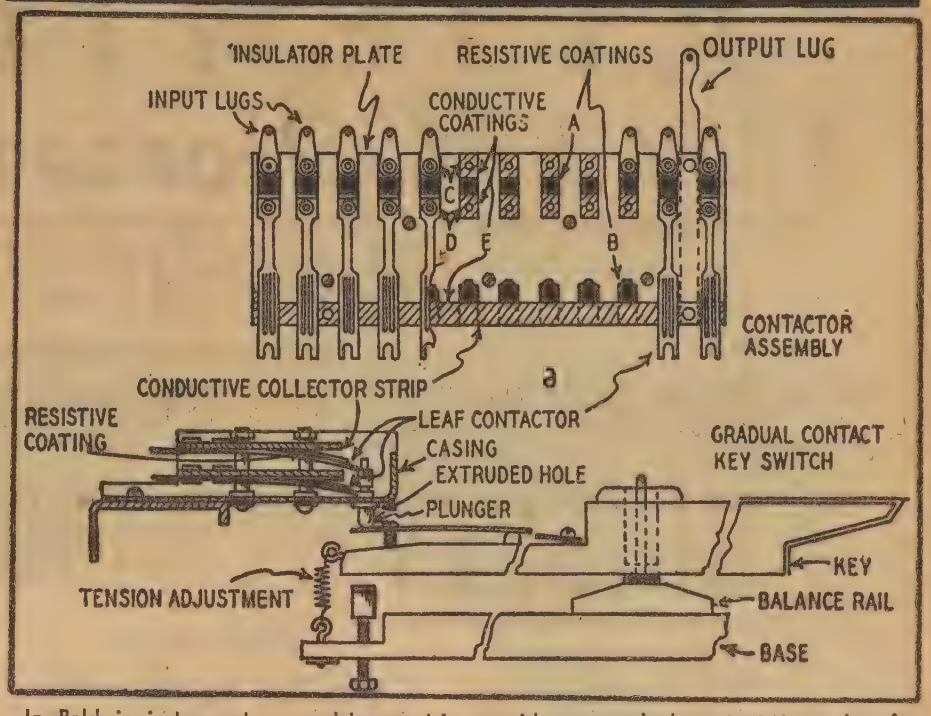

In Baldwin instruments, a resistance strip provides a gradual contact as a key is depressed, thereby avoiding clicks or unduly abrupt "attack".

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, in the fact that the actual
d of the reeds could be heard
well as the tones coming from
speaker.

may be regarded as axiomatic
the only tones to be heard
ld come from the speaker. This
big problem for the home-builder
somewhat difficult to solve.

he writer achieved success in
regard by arranging the reeds so
, from the time the organ was
ched on, all the reeds were
ating all the time, just gently.

OUSTIC OUTPUT

Vind was supplied from an old
uum-cleaner blower, which was
down in speed (and noise!) by
rting a 150w lamp in series with
AC lead. The whole generator
encased in a metal box lined with
tex, and which was then placed
er the floor. Keying was achieved
relays actuated from a distance
he console, the outputs being fed
n preamplifiers in the generator
by a line to the main amplifiers
the console.

his system of having the reeds
rating continuously is to be re-
mended, with one exception—
matter of key clicks.

ey clicks, now pretty well beaten,
e for twenty years been a major
blem in electronic organ design,
one great advantage about
ctrifying" an old reed organ, just
you get it, is that the problem
s not exist.

ou depress the key, this pushes
n (or up) the pallet actuating
ft which lifts the pallet. Here-
n, the air stream rushes into the
d cell and actuates the reed.

he result is that the attack, from
point of view of the player,
organesque, and, since there is
switching of tone screws involved
ll screws being permanently con-
ted to the preamplifier—there is
problem of clicks.

n the section dealing with vacuum
e generators, the ingenious method
he Baldwin people in overcoming
clicks will be shown.

he solution of the problem is one
each experimenter, whether he
ores the clicks (!), avoids them
h a low pass filter or resorts to
tronic keying.

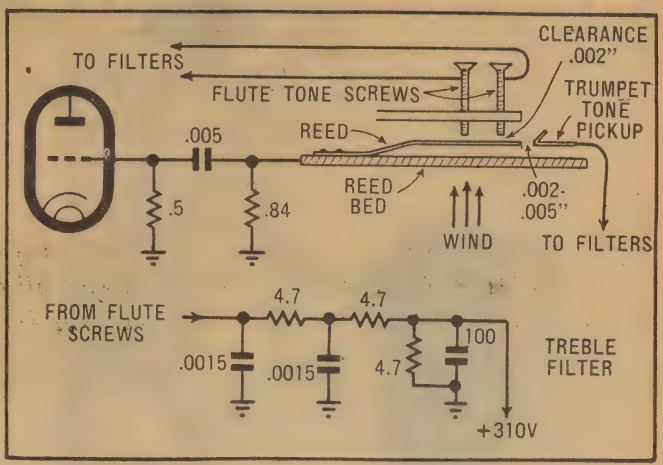
GHT "ATTACK"

With direct keying—that is, with
key moving the pallet—an organ-
build up of tone is available;
h the system suggested the attack
instantaneous, enabling one to
y any type of music. Note, how-
r, that in the latter case it is
ticable to insert a variable at-
k and decay device, an example
which is given in Alan Douglas'
y little book, "Simple Electronic
sical Instruments for the Con-
uctor".

o sum up, the home-builder can
assured of results when "electrify-
" old reed organs—the job is
ple, the cost small and the results,
ll, that 's a matter of taste and
experimenter's field.

n the July, 1955, issue of R, TV &
mention is given to an FM reed
e of generator. While the writer
s not conducted any experiments
h this type of instrument—not long
ving given his full time to vacuum
e generators — the results are
own to be good and, in the main,
erior to existing practices. Mind
u, this technique is not new, much

A PICKUP SYSTEM FROM REEDS



The pickup system from reeds, as used in the Wurlitzer electronic organ. Note that all reeds vibrate continuously at low level in a sound-proofed enclosure.

experimenting having been done as far back as 15 years ago, but the system holds much promise although the expense and extra circuitry are of small moment.

PHOTO-ELECTRIC ORGANS

It is felt that this system will have little interest to the average reader, since the number of people who have access to the equipment for designing and recording photo-electric patterns is negligible — nor is there much hope of experimenting in the subject.

At best, and if expense were no object, it would be possible to have a film sound recording studio record the voice of every single note on a good pipe organ, and then devise a means of reproducing that note on

Segment of a tone pattern disc as used in a photo-electric organ. The principle is not advised for home-builders.

depression of a playing key and a stop tablet.

Many photo-electric instruments have been constructed the two "best" being, probably, the Welter organ (German) and the Baldwin Photo-electric organ. This latter is no longer manufactured, which statement carries a certain amount of significance, and the Welte instrument has not been made since the war, for various reasons of a non-technical nature.

LIGHT PATTERNS

Methods used are (a) recording of sound on film — either variable density or variable area — the original source of tone being a first-class pipe organ, (b) doing the same with a glass disc, (c) actually engraving a glass or plastic disc with the visual pattern of a preconceived tone, or, (d) passing a series of holes in a revolving circular, opaque disc between a light source and a p.e. cell.

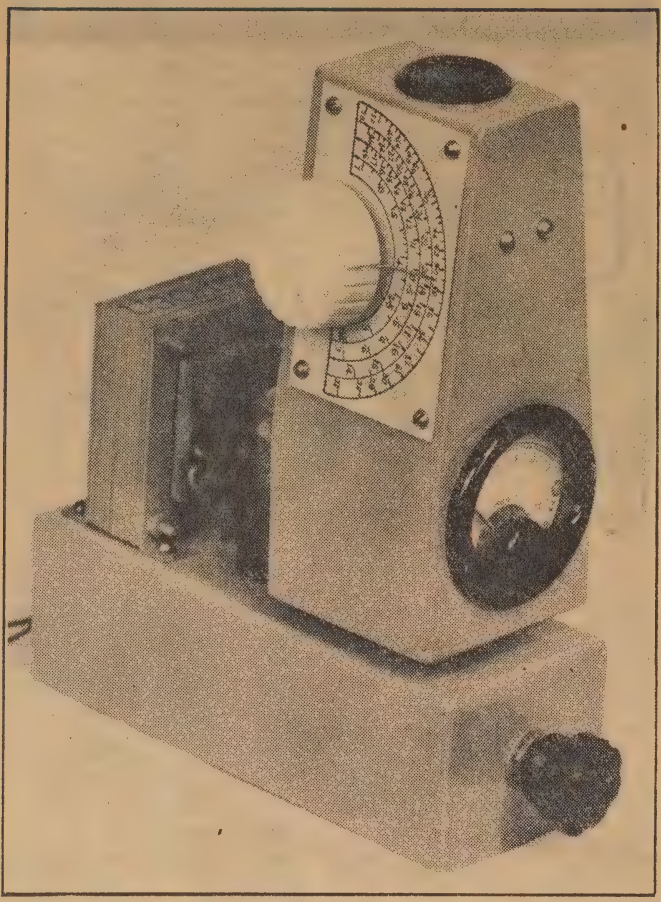
This latter method holds most practicability for the experimenter, the number of holes per second giving the pitch of the note. However, to even start achieving anything in this field it is practically an essential to have one p.e. cell and exciter lamp per note of the instrument — to say nothing of the difficulty of arranging synthesis of desired voices.

An early model, designed by Joan Eremeeff generated sine waves and, by additive synthesis, made pretty fair representation of recognised organ voices.

However, trying photo-electric methods is definitely not advised for the casual experimenter, witness the fact that there is, today, no commercial instrument made on this basis, despite the fact that the field has been thoroughly explored.

Next month, we shall go on to consider the generation of tones by purely electronic means, referring in particular to neon oscillators and valve circuits.

(To be continued.)



The power supply makes a convenien mount for the oscillator and it can b plugged in when required as a fiel strength indicator or a checkin oscillator. When removed from th supply for use as a "grid dipper", connecting cable can be fitted wit plug and socket to join the two unit It can be several yards long.

A UNIVERSAL GRID DIP METE

Here is another Grid Dip Oscillator intended more particularly for amateur use, but having many other applications which make it useful. In design it is simple, but it has been made as compact as possible to get to those inaccessible places. It can also be used with batteries if required.

CONSIDERABLE interest has been shown in the recently described Grid Dip Meter described in these pages by Philip Watson.

This design incorporated a "Magic Eye" type of indicator which not only proved to be very sensitive, but is also cheaper to use than a meter would be.

It was intended as a general purpose instrument for use in workshop and laboratory, capable of covering a wide range down into the VHF region and operated from an AC power supply.

It also used a vernier movement to assist in making accurate adjustments of the indicator dial.

The production of this meter or oscillator left its predecessor lying around the workshop rather disgruntled in having being replaced by something new. Our minds being occupied with the subject of design, we began pulling it to pieces to see whether we could produce a new instrument, still using the meter, which would be more convenient than the old.

Little by little a device was evolved which we now consider sufficie ly different and interesting to m an article of its own. Most of features have been worked out w the peculiar requirements of an teurs in mind, but it can be n the less useful for general work.

It might be as well to set the main requirements at the st for from them the general sha of things emerged.

The first of these was the use a 0-1 mA meter, because that the type we had on hand, and the one most people will use.

It is a standard 1000 ohms volt meter, and has proved to quite sensitive enough for the A more sensitive type could used, but normally such a me would be considered worthy of m exacting service, apart from higher cost.

METER SIZE

There are quite a few 2-inch mA meters, which have been through disposals, although the we had was something of a re having one main virtue — it probably as large a meter as any is likely to use.

By using it we can be reasona certain that any 2-inch meter have will fit into the case we h designed.

The second requirement was t the little case which housed "doings" should be as small as p sible so that it would lie conve ently in one hand. The fron area also had to be small so t the coil in use could be inser into all those awkward positions a angles which often arise in practi without fouling against other co ponents, the edges of chassis or uprights of a transmitter rack. T is the reason for the pointed sha of the case.

It could not be narrowed to measurement smaller than needed accommodate the coil socket its nor could it be sloped on all fo faces if we were to preserve a su ably shaped area on one side to t the calibration scale.

Moreover, such a procedure wo

the construction of the case much harder without really ng a worthwhile advantage.

third requirement we have just ioned—a suitably placed and nsioned scale. The placement his scale had naturally to tie with the mounting of a suit- tuning condenser in the case. you will see, by sloping the almost from the bottom of the we were able to secure suffi- flat surface for a scale carry- four calibrations with plenty of n. Five calibrations could be mmodated if desired.

e fact that the scale is at the of the case means that, although not always visible in use, the is very conveniently situated operation with the left hand.

ou can demonstrate for yourself , with the scale on the front el, it is generally more awkward turn the knob than it would vith the knob at the side.

hen the reading has been taken, the case is moved toward you y from the equipment being sured, the right hand makes a turn quite naturally, and the brated scale automatically comes view.

ALE POSITION

ome people like to have both le and meter on the same face. viously, apart from any other siderations, this cannot be done he case is to be kept small.

nother point to be considered is t the tuning condenser must be unted right next to the coil socket leads are to be short. By a cess of elimination, remembering these things, side-mounting was ided upon.

he meter must be in front of eyes when the device is being d, but need not be near the tuned cuit. Its obvious place, therefore, s at the bottom of the case and its front face. The whole of the ice here is set aside to accom- date the meter.

f a large knob is used, similar that shown, the lack of a slow- tion dial will not be noticed. ere is no difficulty in obtaining fficient control. Our pointer was ade from a piece of stiff wire ed into a fine hole drilled in the derside of the knob.

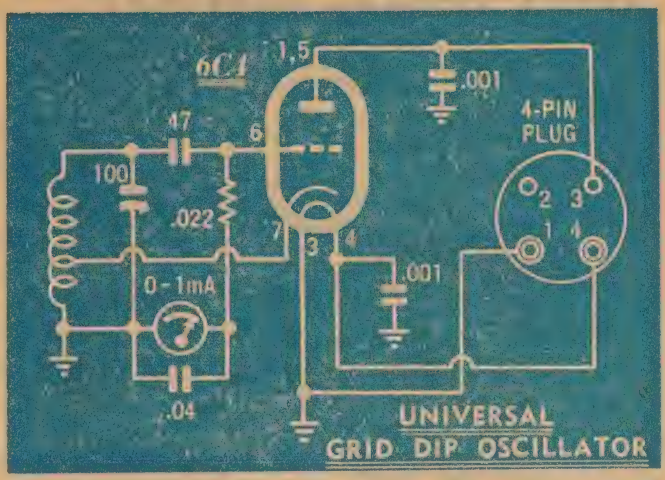
RTHED ROTOR

The edge of the knob will pro- ide slightly beyond the edge of e case. It can therefore, be anipulated by a finger of the same nd which holds the case, if this ould be necessary.

In the interests of simplicity, a rcuit was to be used which enabled e spindle of the tuning condenser be earthed.

Where space is to be saved, this quite an important point. With a ating rotor, insulated mounting id coupling is necessary, both of hich take up room, and would have ade it impossible to cut down the ontal area of the case. The circuit sed, therefore, was a perfectly andard arrangement, with a tapped il for cathode connection, such s has been used for many years ith oscillators of this type.

OSCILLATOR CIRCUIT DIAGRAM



The oscillator circuit is a standard type. A low drain valve permits battery operation if required, and being a VHF type good oscillation is assured at high frequencies. Miniature components should be used.

Still further requirements, as we became more ambitious, were that the meter should be suitable for AC operation as the normal thing, but also for battery power on occasions where this might be necessary. And, if possible, it should be usable for purposes other than the original to increase its usefulness in the "ham shack".

Battery operation was looked after by separating the power supply and using an oscillator valve whose cathode can be powered by batteries without incurring too much drain.

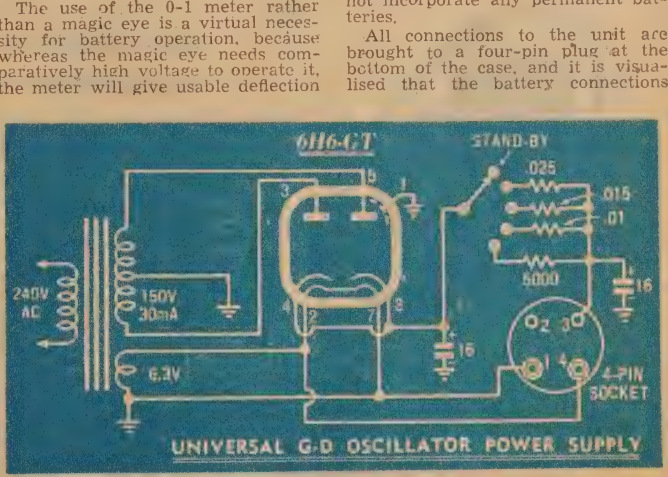
The use of the 0-1 meter rather than a magic eye is a virtual necessity for battery operation, because whereas the magic eye needs comparatively high voltage to operate it, the meter will give usable deflection even with 67½ volts of high tension, and on some ranges will give practically full-scale deflection with this voltage.

The valve used, a 6C4, is a standard triode specially suited for VHF work, and has a filament drawing only 150 mA, a modest load for quite small dry cells.

A Minimax battery would be quite in order for high tension, as the plate current is small.

Battery operation, however, is not likely to be needed except in an emergency, so that the design does not incorporate any permanent batteries.

All connections to the unit are brought to a four-pin plug at the bottom of the case, and it is visualised that the battery connections



The power supply uses a low-cost rectifier and power transformer. The switch changes the value of the filtering resistor to vary high tension voltage and meter sensitivity. A stand-by position allows the high tension to be removed from the valve for some purposes.

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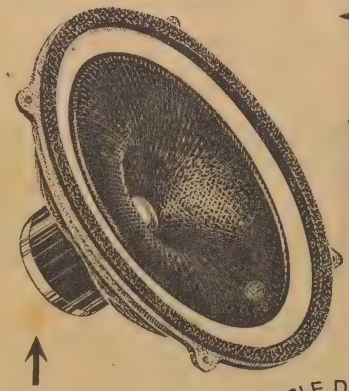

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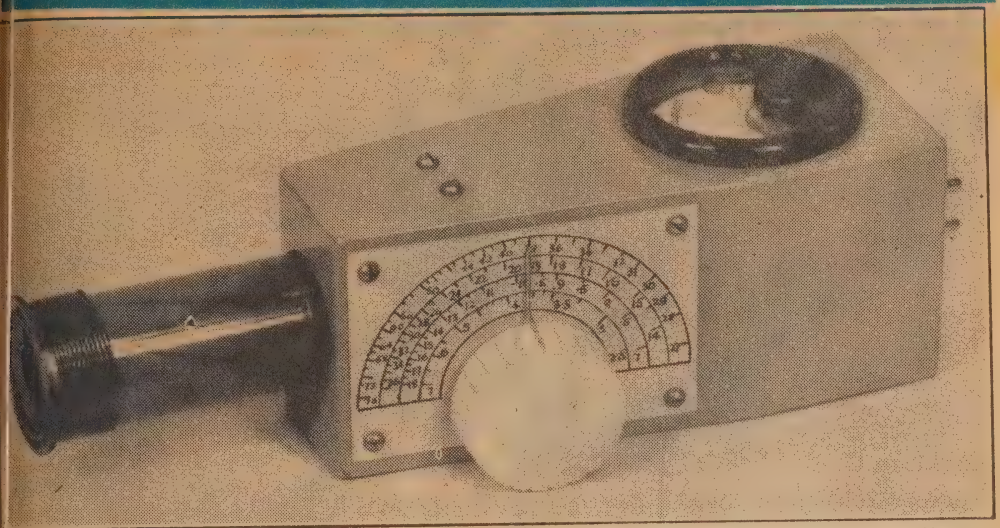
THE OSCILLATOR UNIT WITH COIL IN POSITION



Here is the oscillator unit of the grid dip meter, showing one of the coils in place. You can see, too, just how the calibrations were made. Note the large knob for easy adjustment.

ll be made with a suitable cable minated in a four-pin socket. It is quite surprising how many es one can devise for the unit hen it is not required for "dip ng".

For instance, it can be used as calibrated oscillator for checking e lining up of a receiver, a field rength meter, or a transmission odulation indicator.

By adding a phone jack in the ate circuit it makes a good monitor. It is by no means a "one job" oject.

Most of these additional uses will require a method of mounting the unit where it can be easily handled and seen, and which will not take up too much space.

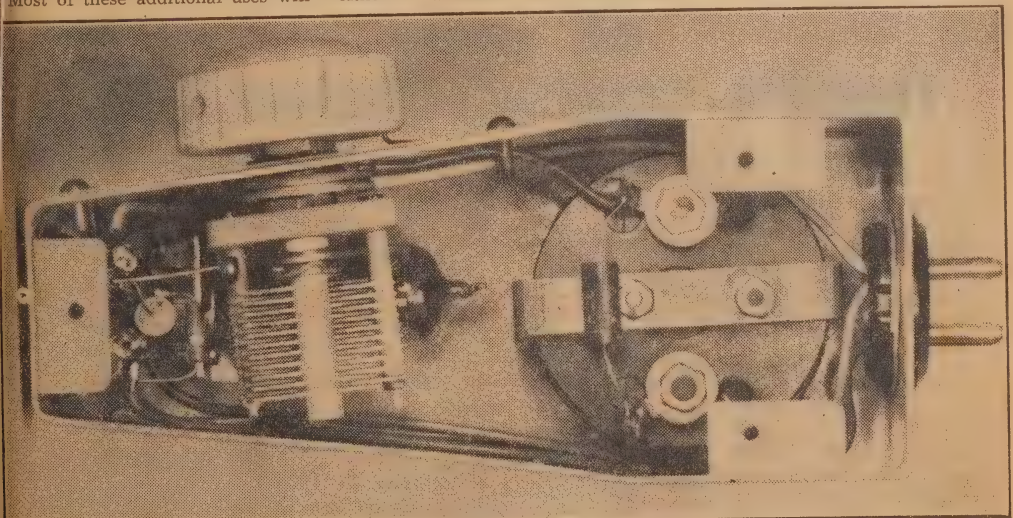
Our solution to this problem was to provide a socket on the power supply, which would receive either one end of the extension cable, or the four pin plug on the case itself. The unit is, therefore, a plug-in device, which sits on its own power supply, and will operate there just as though connected to the cable.

In this position it can function either as a simple oscillator or as a field strength indicator in a manner to be described.

There is no particular need to give added support to the unit when plugged into the supply, although four rubber feet could be fitted either to the case or to the power supply, of sufficient height to steady the four corners.

The connecting cable can either be stowed away for future use or wound around a couple of hooks mounted to one side of the power supply, where it will be immediately available when wanted.

The power supply is a very sim-



The oscillator unit with the bottom plate removed. The tuning condenser and the valve beneath it are clearly seen. The coil socket is obscured by one of the brass angle brackets to which the bottom plate is bolted. These are mounted just below the edges of the case so that the plate lies flush. Wiring up is very simple.

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Length: 7¼in. Depth: 5in.
Height—Chassis: 2¼in. Total: 5¾in.

MOUNTING:
Unit is mounted on right hand side of chassis with IF channel along back. A cut-out 6in x 4¼in is required with 4 holes, centres 4¼in x 6¾in apart.

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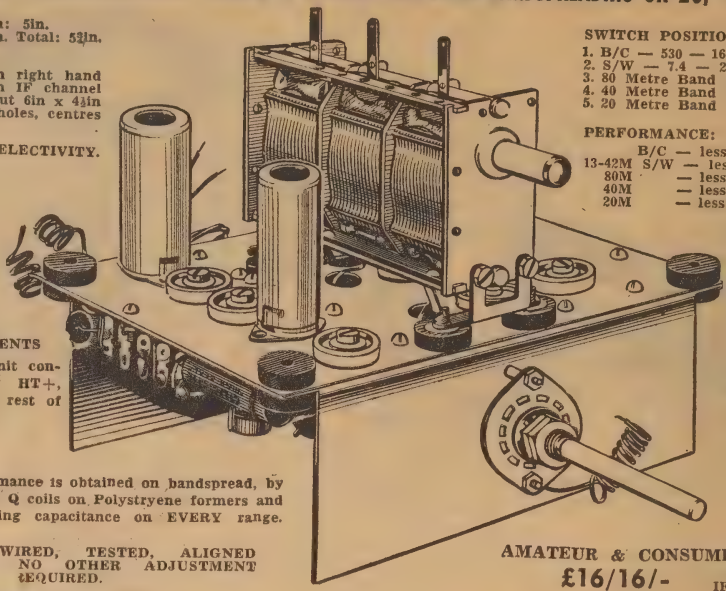

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affair. It uses a small power former—the smallest available ing about 150 volts with a drain nly a few mills. A single 6.3 winding will serve for both lator valve and rectifier. The r is a 6H6 type available for w shillings from disposals stores.

ie 6H6 is a very useful little fier for such purposes, and will ly up to about 10 mills at volt- much higher than 150. In this ection it should be everlasting, its very low cost makes it al- disposable.

irly good filtering is used to the oscillator note clean, and rovided by two 16 mfds electro- s and a resistor in place of a ce. The condenser value isn't ortant and eight mfd condensers ld probably do just as well.

he resistor value is variable— different values being selected

Coil data

Range 2.75 Mc. to 7 Mc. 35 turns of 24 gauge enamelled wire tapped at 12 turns. Wound on 1¼ inch 6-pin former close-wound.

Range 7 Mc to 18 Mc. 12 turns of 18 gauge enamelled wire tapped at 4 turns. Wound on 1¼ inch 6-pin former, close-wound.

Range 14 Mc to 36 Mc. 9 turns of 18 gauge tinned copper wire tapped at 4 turns. Wound on ¾ inch former grooved 16 turns per inch (Jabel).

Range 27 Mc to 76 Mc. 3 turns of 18 gauge tinned copper wire tapped at ½ turn. Wound on ¾ inch former grooved 16 turns per inch (Jabel).

The gauge of wire should not vary greatly from that given, but enamelled wire of suitable gauge could be used throughout.

When correct coverage is ascertained, but before calibration, the windings should be fixed in place with coil cement.

A flat circular disc of 1 inch diameter may be cemented to the top of the highter frequency coils to prevent damage. All windings should be wound at the top of the former.

a switch at the front of the sup-

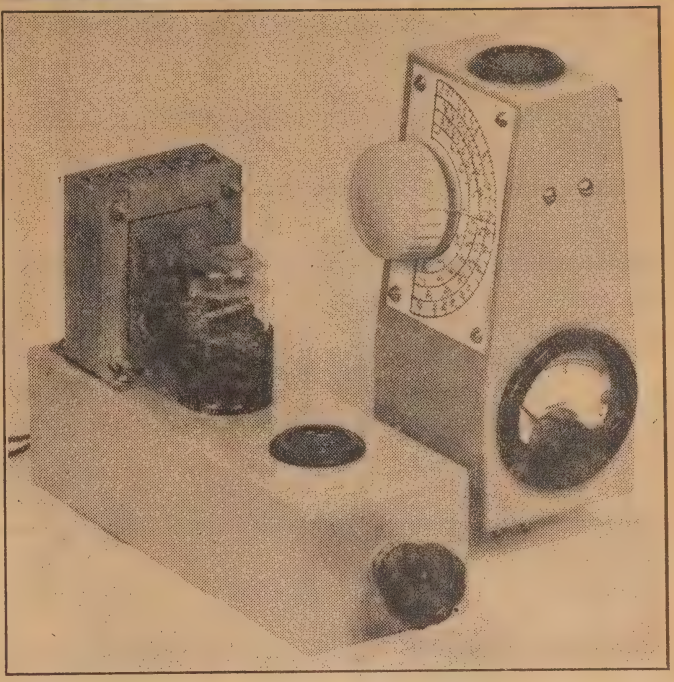
It will be found that the grid rrent of the oscillator varies quite nsiderably from band to band, ing greatest at the low frequen- es. The simplest way to adjust nsitivity is to vary the filter re- stance, which also varies the high nsion voltage, and the values ven will allow substantially full ale deflection on each band. It is iite permissable to make small anges in value to achieve this if should be necessary.

On the highest frequency band, ll scale deflection may not be ssible.

The switch breaks the high tension rcuit in one position. This is for e when the meter is operated to easure field strength. In this con- ection the valve is required to ork as a diode, and the high ten- on must be removed.

It isn't as sensitive as a regular ode would be, but if the coil con-

TWO UNITS SHOWN SEPARATED



Here are the two units with the oscillator "unplugged" from the power supply. They are joined with a connecting cable when separated in this way. There was no terminal for aerial connection on the oscillator when these pictures were taken.

cerned is connected to an aerial, there is plenty of sensitivity to give a good meter deflection with a transmitter in action, when the right coil is used and the meter tuned to frequency.

Should deflection be too great, the circuit is detuned until the right setting is found.

Never switch the oscillator into operation with an aerial connected, for in this condition it will radiate and may cause interference with other services.

The best way to provide for aerial connection is to wind one or two coupling turns at the bottom end of each coil, connecting one end to the earthed pin on the former, and the other to one of the vacant pins.

A terminal can then be mounted on the top of the meter alongside the coil socket, and the free end of the coupling coil connected to it.

An aerial is connected to this terminal when it is desired to indicate field strength. It need not be large and the best length will be found by experiment.

The meter will indicate when the transmitter is on, and, if modulated, the needle will show a rise to confirm that modulation is effective. It is a most useful device used in this manner.

The construction of the oscillator is shown in the illustrations more fully than can be described in words.

The case is made from 18-gauge

PARTS LIST

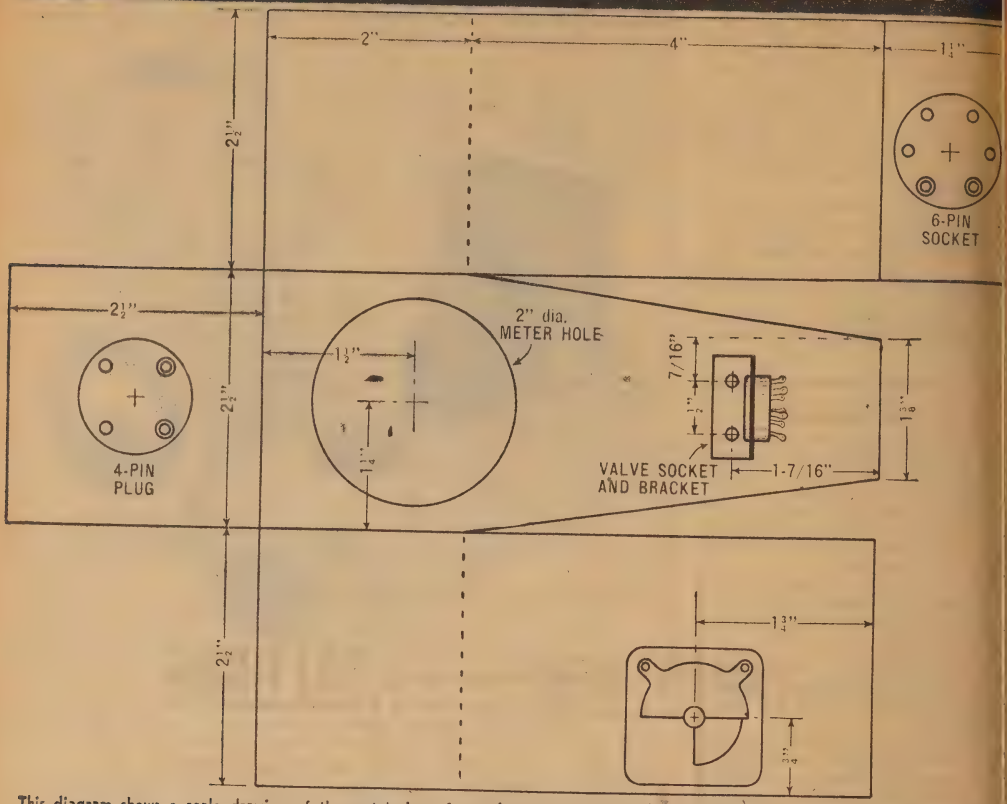
OSCILLATOR UNIT

Chassis as detailed.
Valve—6C4
Tuning condenser 100 pf Eddystone or equivalent size.
Valve socket—7-pin miniature
Meter—0-1 milliameter, 2-inch
Resistors—.022 or .025 ½-watt
Condensers—1 47pf ceramic, 1 .04, 2 .01 baby tubular, 200 volt working or greater.
1—4-pin Amphenol plug, manufacturer's type.
1—1½ inch tuning knob.

POWER SUPPLY

Chassis—6½ x 2½ x 2 inches with bottom plate.
Transformer—150 volts at 30 mils, 6.3 volt filament winding.
Rectifier—1 6H6
1—5-position switch
2—16 mfds 250 volt working electrolytics
Resistors—.025 megs, .015 megs. .01 megs, 5000 ohms 1-watt.
Sockets—1 Octal, 1 4-pin manufacturer's type.
Power cord and plug, knob, hook-up wire, etc.

SCALE DRAWING OF THE OSCILLATOR CHASSIS



This diagram shows a scale drawing of the metal sheet from which the oscillator case was made. Note that when folded, the vertical sides will lie inside the boundaries of the centre section, and that the final fold of the top section will lie flush with the side which it meets. Fortunately small blemishes can be filled with solder and filed smooth, but we had no trouble with it. This diagram also shows the positions of the major components.

tin-plate, merely because this happened to be available. The butt joins were sweated together and cleaned up with a grinding wheel and a file. This gauge is heavier than necessary, and 20 gauge would be about right. Either tin-plate, steel or brass is best, as aluminium cannot be soldered, and would have to be held together with brackets.

Our diagram shows how the tin-plate was cut out with a hacksaw and folded into shape. The bending can be done in the average vice with the aid of some stout wooden strips for the hard bits.

The chassis for the power supply was made in the same way, but here the bending is much simpler.

CHASSIS HOLES

The holes were cut after the metal work had been finished and cleaned up. Socket punches are used for the valve sockets, but the 2in meter hole is best cut by drilling a circle of holes close together, breaking out the centre, and cleaning up with a half-round file.

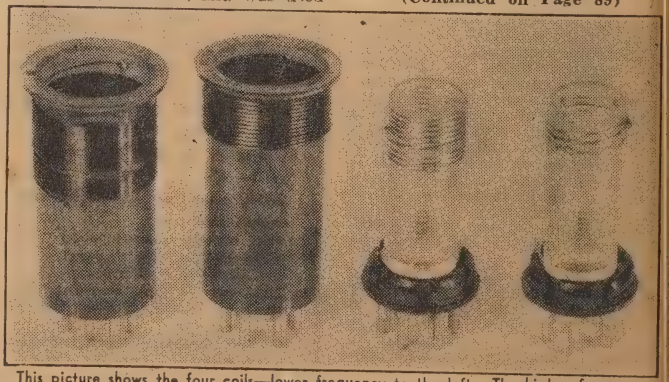
Small angle brackets were soldered to both chassis, and drilled and tapped so that a bottom plate could be screwed on when finished. Thus both are completely sealed up, preventing damage or "bites" from high tension when moved about. These brackets can be seen on the underside view of the chassis.

When all the holes were made, a coat of grey lacquer gave a finish, inside and out.

Positioning of components is illustrated by both photograph and drawing. The condenser is an Eddystone 100 pf single section, and was used because it is small, rigidly made, and has shaped plates to give better band-spread than with semi-circular plates. It is mounted near the chassis edge to allow for the largest possible scale.

The valve is mounted on a small bracket, the bolt-heads for which can be seen in the photographs.

(Continued on Page 89)



This picture shows the four coils—lower frequency to the left. The higher frequency coils have their formers bolted to standard Amphenol 4-pin plugs.

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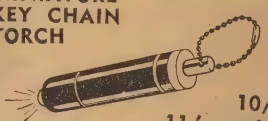

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CUT OUT ALONG LINE

UNIVERSAL GRID DIP METER

(Continued from Page 86)

placed that its connecting lugs rtually touching those of the valve socket—an Amphenol acturer's type.

valve actually lies beneath the nser so that all circuit connec- are as short as it is possible to them.

th connections are made to a lug, securely mounted under f the bolts holding the valve t. The bolts holding the bracket almost certainly bite through aint to earth to the case, but sure that they do.

ly three pins are used on the ocket, so that some of the others e used for tie points. Minia- components are needed to fit the space.

e whole thing is best fitted to- r before wiring. Then the valve t is wired, the condenser being ted last of all.

e meter is held in place by a ket which bolts to the case. type of meter has its own mount- method.

VER SUPPLY

iring the power supply presents difficulties. The main thing to h is that the output socket is nted far enough back from the to clear the switch, and that oscillator, when mounted in this et, does not foul the rectifier e. Once again be sure, and sure everything up before cut- into the metal.

he switch is an ordinary 5 x 2

he four coils we used cover from Mc up to 76 Mc with plenty of rlap.

hey were designed so that the ateur bands commence at the h-capacitance end of each, which es the best bandspread and the t deflection of the meter be- se of the higher circuit Q.

t would, of course, be permissible start and finish your coils at dif- ent spots, and to add to their mber if desired.

HF COVERAGE

A simple centre-tapped hairpin il has been made and operated wn to 144 Mc but it is not in- ded that this meter should ex- nd to VHF work. A hairpin about in long would do quite well to tend the VHF coverage.

It could be used with a split- ator condenser of smaller capacit- ice and a suitable circuit, but only the expense of the lower fre- uency coverage. A separate unit best for VHF work down to 144 c.

The two lowest frequency coils are ound on 1¼in formers, as most f the coils with which they will e used are of several inches in iameter. Smaller formers would ot give such good coupling.

The two higher frequency coils re wound on Jabel type grooved ormers of ¾in diameter. A bolt uns through the six-pin Amphenol lugs with which they are used, and nount the formers firmly to them.

Small holes are drilled through he former near the plug pins to which the coil ends are soldered for connections.

Taps on these two coils may be made merely by spot soldering the connecting wire to the winding either before or after winding.

For the low frequency coils it is best either to run two leads to the coil pin from the tapping point, or to solder the leads together inside the former, continuing down to the coil pin with only one of them. Sometimes two wires cannot be fed through one pin.

Do your soldering to the coil pins as quickly as possible, and hold each pin with a pair of pliers. These will prevent the pin from being overheated, thus melting the former material.

The calibrated scale is made of good-quality heavy paper or thin card, covered with a layer of celluloid to keep it clean, and bolted to the case with tapped holes. Ours measured 2¼ x 3¼in, and when finally calibrated, the numbers and markings were made with Indian ink.

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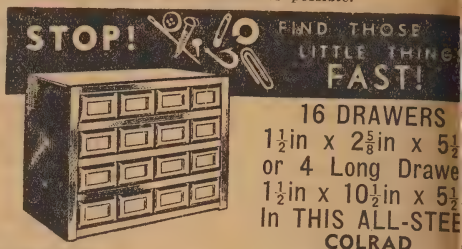

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The 1955 Babygram (p. 60)

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Playmaster Nine (p. 60)
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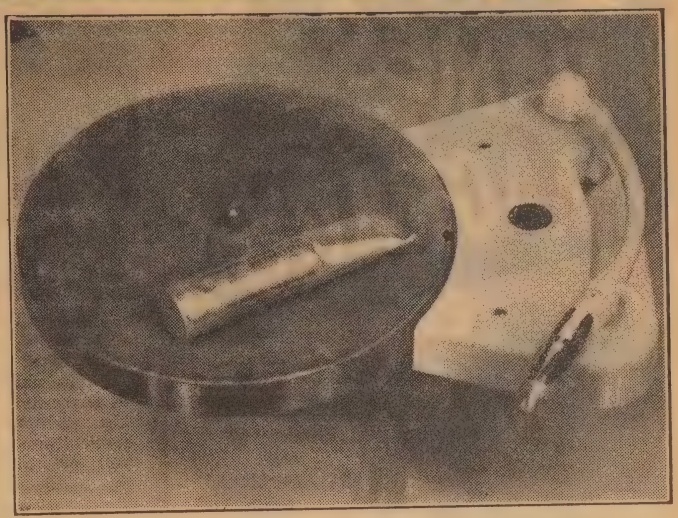
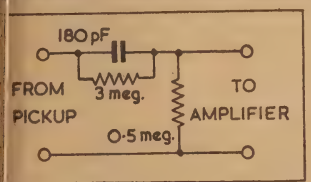
TRADE REVIEWS AND RELEASES

e AG2002 record player unit hich has been sent to us for re-ew has a particularly neat ppearance, as well as perform-ice which compares very vorably with others in its class. attractive bakelite super-ructure and stream-lined head nd arm look well enough to grace any type of cabinet.



A photograph of the AG2002 player unit. Retail price is £12. Heads cost 29/- each.

IE motor is a small but powerful shaded pole induction type sup-d with a spindle turned down to e stepped diameters.
he spindle engages a flexible r pulley which in turn supplies e to the outside rim of the turn-e.
he motor is mounted to a metal ne bolted to a plate which nts to the motor board with ber supported brackets.
he pick-up is mounted on a tic moulding which also acts as indicator plate for the speed-nge lever. This lever is spring ted into the three speed posi-ns, and a fourth which disengages drive pulley as a rest position.
he turntable is made of die-cast tal, machined and fitted with a l-bearing thrust. It revolves on

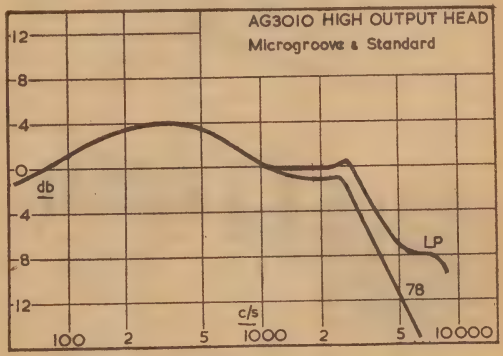


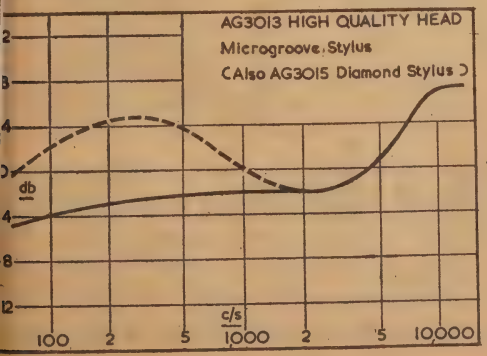
spindle attached to the motor ate.
Several heads are available for e player unit. All are streamlined plastic, and in the dual stylus pes, a sideways twist selects the sired point which is indicated by color dot.
The AG3010 is the dual stylus ad, having a high output and rising ss characteristics making it par-ularly suitable for simple receivers id amplifiers.
The AG3012 and AG3013 are ex-tended range heads fitted with a single stylus for 78 and LP records respectively, the latter being obtain-able with a diamond stylus as the AG3015.

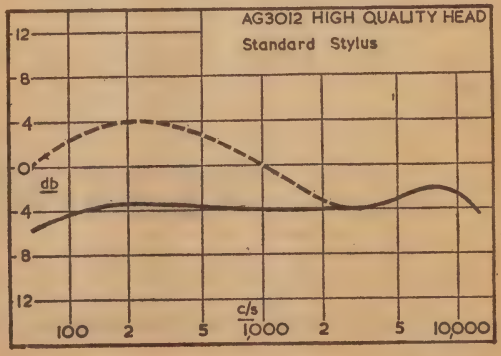
This unit gave good results when used with the amplifiers described in this issue, and the sample shown here was supplied by Mullard-Aus-tralia Pty. Ltd.

☆

These three curves illustrate the per-formance of the three pick-up heads mentioned in this review. At left is a compensation cir-cuit recommended for type AG3013.







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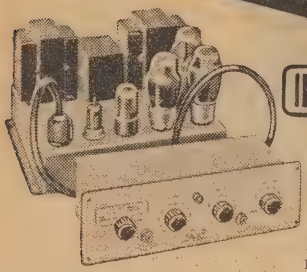

LEAK

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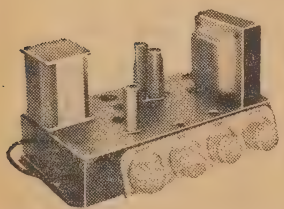
TL10 Power Amplifier and "Point One" Pre-Amplifier. Triple loop feedback circuit. Max. Power Output: 10 watts. Frequency Response: plus/minus 1 db 20 c/s to 20,000 c/s. Harmonic Distortion: 1 pc, 1000 c/s 7.5 watts output. Feedback Magnitude: 26 db main loop. Damping factor: 25. Hum: 80 db ref. to 10 watts. Speaker Impedances: 16, 8, and 4 ohms. Pre-Amplifier operates from any branded pickups. Instantaneous use of crystal, moving-iron, and moving-coil pickups. Radio input sockets permit connection of any tuner-unit. Distortion: order of 1 pc. Hum: negligible. Input Selector: radio, tape, records accurately equalised. Continuously variable Treble and Bass. Features Vol. control and power switch and Tape Recording Jacks.



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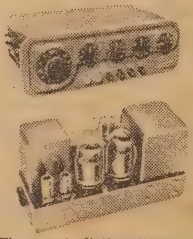
The speed change is arranged mechanically and gi a 2 pc variation on all speeds, the synchronous mo running at constant speed at all settings. No break action is employed to obtain speed change.

It is suitable for playing standard transcription microgroove recordings. Input voltages 220/250 v. 50 cycles, or as specified to order for 200/250 v. 60 cycles, or 110 v AC 50 or 60 cycles. Mounted ¼in die-cast board 15¾in x 13½in with 3¾in clearan distance below motorboard. Speed selector turret fitted at left rear of motorboard. On-off switch at l front also releases pressure on rubber drive assemb All motorboards are drilled to take Connoisseur Star ard and Super Lightweight Pickups unless otherw ordered. When used with these pickups mounted position 3¼in clearance abo motorboard is recom mende



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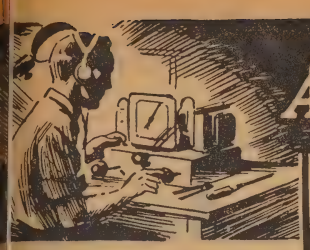


A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A SMALL OIL BURNER FOR THE HOME WORKSHOP

is month we have a design from Mr. J. Heath, Mountfield Av., Chadstone S.E. 10, Victoria, for oil burner. This unit is said to be suitable for elting metal for small castings, hardening or mpering steel tools or for heating a small boiler.

E construction of this oil burner loes not require any special tools than a drill press. All materials obtainable from the local hard- store if not already on hand. A um cleaner is used as the air er and old sump oil as the fuel. mensions of the unit are not icularly critical, but the dis- e from the oil supply tank to the heater coil should be kept to a imum (6-7in) otherwise a larger meter tube or thinning the oil with sene will be necessary. How to e the stand and fit the tanks ld be clear from Fig. 1.

ne functions of the burner are:— Heating the oil to make it thinner. Breaking the oil into small drop- (3) Regulating the amount of and oil supplied.

E-HEATING

reference is made to Fig. 2, the s through which the oil passes pre-heating will be seen around piece of 1¼in pipe, atomisation of oil taking place at the nozzle by action of the air stream passing r the central jet.

egulation of the air supply is ob- ned by screwing the front plug in out, and regulation of the oil sup- by means of the valve wheel at back of the burner.

Construction of the burner com- nces by drilling a 7/16in hole cen- lly in each plug.

Next the 7/16in brass rod is drill- to form the centrepiece of the rner.

The 3/16in hole is drilled first to depth of 1 5-8 inches, the drill changed to a 3/32in and the hole deepened by about ¼in. The brass rod is then drilled from the other end with the 3/32in drill until the holes meet. With care in starting the drills and lining up, the holes should meet centrally.

Care should be taken with the finish of the taper left by the 3/16in drill, as this forms the valve seat. The holes are then tapped ¼in and 1-8in Whitworth respectively.

The brass rod is then held in the drill against the rod. It is important that, when finished, the 3/32in hole be concentric with the outside of the tube end.

To make the jet, drill a No. 54 hole through the centre of a 1/8in brass bolt. This part is the most difficult of the whole job, but it can be done if a clean centre punch mark is made in the centre of the end of the bolt and the bolt held vertically under the drill press.

☆

This diagram shows the general position of the various parts of the burner and the fuel supply tanks. The burner and vaporiser tube should slope downwards slightly to prevent any unvaporised oil running down into the furnace.

☆

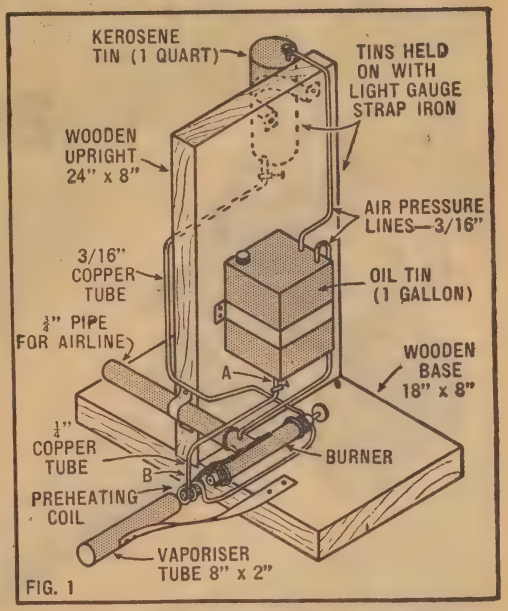


FIG. 1

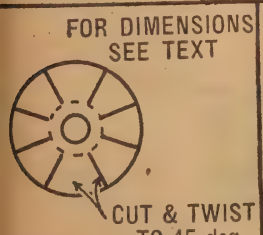


FIG. 3

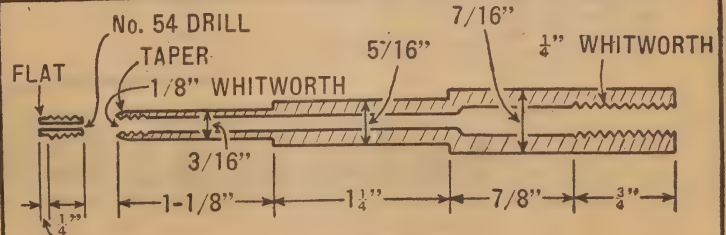
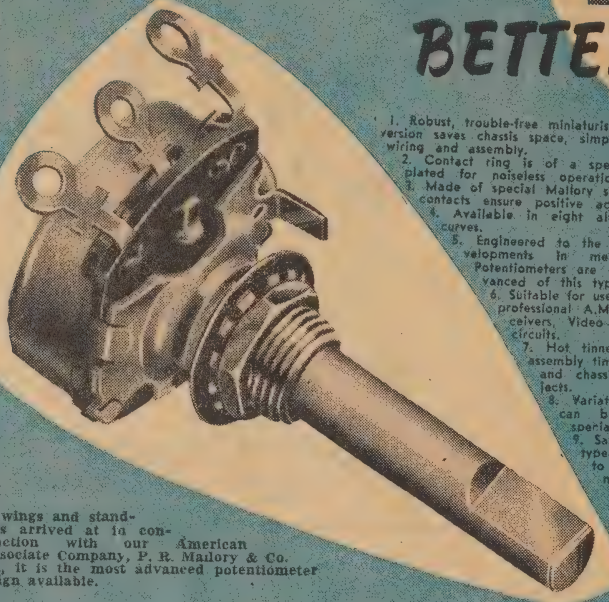


FIG. 4

These diagrams give details of the swirler disc and a cross section view of the jet tube.

9 reasons why... DUCON BETTER



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8. Variation to standard can be supplied to special order.
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LOOK

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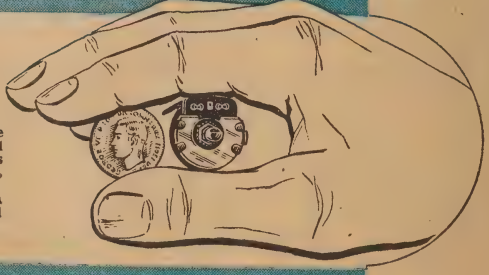
Write or phone for our Potentiometer Data Sheet, which gives you full engineering and electrical data.



DETAIL CROSS-SECTION DRAWING OF THE BURNER

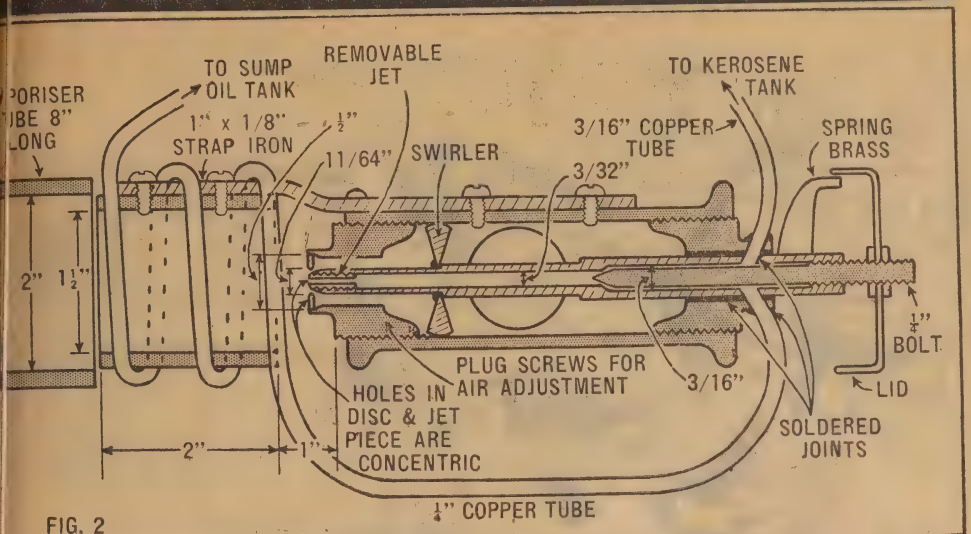


FIG. 2

This shows the placement of the various components in the burner and the air and throttle adjustments.

jet is then screwed into posi- nd cut off about 1/16in from id of the rod; two small flats led on it to enable withdrawal eaning.

disc of brass is then cut out 3) to form the swirler. The ter should be the same as the al diameter of the T pieces at nd threads; the hole in the e is 3/16in.

POSITION

der this disc in place on the al brass tube and screw the with the 7/16in hole into the end of the T piece. Position ube in the hole and solder to the allowing the jet to protrude n from the front end of the T and in the centre of the hole. draw the plug and tube and cut bend the swirler vanes.

e second plug is fitted with a disc 1-16in thick through which 1/64in (chamfered) hole is made. hole must also be central with hole in the jet.

he easiest method of ensuring is to put a little Prussian blue he jet and screw down the plug the brass disc fitted until the just touches the jet. A centre ch mark is made where the blue marked the disc, and the hole ed.

ADJUSTMENT

e success or failure of the burner ends on maintaining the hole in disc and the jet concentric when plug is screwed in or out for air stment, so a little care and ence at this stage is well repaid. he oil regulation valve is made n a 1/4in bolt 3in long with a full- th thread. The bolt should be a t fit in the 1/4in tapped hole to vent oil leaks. The head is cut and the bolt held in the drill ss. With a file, the diameter is uced to 1-8in for a distance of 1in, the end of the bolt being tapered to a point.

The valve is fitted with a wheel which can be made from a small lid of a paint tin or jar. A small piece of brass, bent to the shape shown, may be used to hold the valve in the set position.

Holes are drilled and tapped into the T-piece to take the strap holding the pre-heater tube; holes are also drilled in the rear plug to take the fuel lines. The fuel lines are soldered into position, although unions may be used. The piece of 1/4in pipe is then fitted to the strap and about three turns of 1/4in copper tube placed around it. If heavy sump oil is used, more turns may be necessary.

AIR BLOWER

A one-foot length of 3/4in pipe is connected to the centre of the T-piece for the air supply. The vaporiser tube is fitted to an additional supporting strip and the unit is complete.

To operate the burner, a vacuum cleaner as a blower is connected to the air tube and turned on. The tap on the kerosene tank is turned on, and the valve and air control plug operated till an even spray of atomised kerosene is obtained.

The spray is then carefully ignited with a paper spill and the air and fuel controls regulated until good combustion is obtained.

After 2-3 minutes the oil tap is turned on, the kerosene tap turned off gradually, and the valve opened slowly until the burner is operating on the oil.

PARTS LIST

3'6" of 8" x 1½" hardwood.
1' of ¾" water piping threaded one end.
1 ¾" T. Piece.
2 ¾" Plugs
8" of 2" water piping
2" of 1¼" water piping
5' of 3/16" external diameter copper tubing.
2'6" of ¼" external diameter copper tubing.
1- 3/16" Cock.
1- ¼" Cock.
1-1 gallon oil tin (with screw cap)
1-1 quart oil tin (" " ")
4" of 7/16" brass rod
⅛" x ½" bolts and nuts, scrap brass, sheet and scrap iron, wood screws, solder etc.

OPERATION HINTS

Our reader gives in his letter a few hints for the best operation of the unit and the safety of the operator.

(1) The sump oil which is used for fuel should be free of water and foreign matter and should be filtered before use.

(2) Do not spray kerosene and air mixture into a furnace and then light it, as an explosion may result. Always have a paper spill alight ready before the kerosene is turned on.

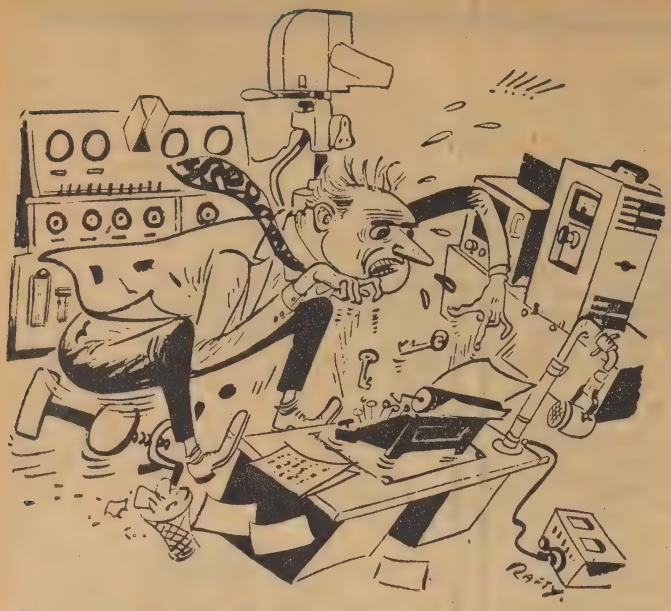
(3) If the furnace has a 3-4in lining, a corresponding reduction of vaporising tube is permissible.

(4) Most efficient combustion is obtained when the oil-supply is reduced to just below the point where smoke is produced.

(5) The screw caps on the fuel tanks should be reasonably airtight.

RESISTOR CHART

In response to numerous requests we are making available through the Query Service copies of last month's Resistor Color Code Chart, printed on art paper, for those of our readers who would like to make a really professional looking job.



Let's Buy An Argument

As a change from this never-ending discussion about high fidelity problems, I have deliberately turned aside this month to a couple of letters dealing with general circuit design. The first one, reproduced on the opposite page is a perfect illustration of a very "popular" misapprehension regarding power output.

by Neville Williams

ACTUALLY there are two or three points in the letter which warrant special comment and I suggest you read it without further ado. Maybe you can pick the points out for yourself. It will be good practice if we ever change places!

First of all, our reader wants to know about the bias voltage. What should it be for class B operation and by what method should it be applied?

But not so fast! Let's take another look at that grid circuit and see how it lines up with the requirements of a class B output stage.

WHAT IS CLASS B?

There was a time when I, like many others before me and since, believed that a class B stage was simply one that used a transformer and operated with zero grid bias. I remember building myself a big set with two "class B" output pentodes (not a whit of bias) and I still don't know why those pentodes didn't melt before I discovered my mistake!

In point of fact, a class B stage is one which operates with enough bias to reduce the idle plate current almost to zero. On signal peaks it is assumed to receive sufficient excitation to carry the grid positive with respect to cathode, so that grid current flows during portion of the input cycle.

This means, of course, that the grid circuit must consume input power equivalent to the product of the grid signal voltage and the resultant grid current. The driving power must be supplied by the preceding valve, which, therefore, earns the title of "driver" stage.

My own misapprehension was based on the fact that all the class B stages I ever had anything to do with had been built around small battery valves with grids of such fine pitch that very little plate current could flow, even with zero bias. In other words, they were high-mu power valves especially designed for class B operation.

I have since learned that zero bias is not an essential feature of a class B circuit, but merely a convenience. That many other valves require quite a substantial negative grid bias to reduce their idle plate current to near zero.

What our present correspondent has overlooked is not the need for bias, but the fact that the grids of a class B stage draw substantial current when driven positive with respect to cathode. And through what can this current flow?

GRID CURRENT EFFECT

In the modulator circuit tended for comment, the answer is "through grid resistors". Though the values are not marked, one must expect them to be nothing smaller than 100,000 ohms. And even 1 milliamp of grid current flowing through 100,000 ohms would ostensibly produce a negative grid potential of 100 volts—a rather disturbing thought.

What it really means is that every effort to drive the grids positive on signal peaks would be invalidated by the tendency of the grids to generate an opposing negative bias across their own return resistors. In fact, their behavior would be closely analagous to the action of a diode detector operating into an AVC load.

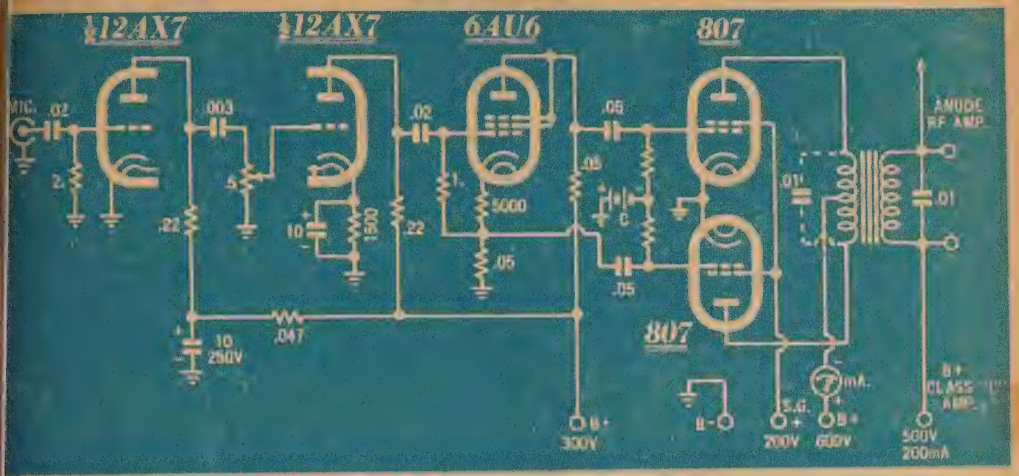
The answer to the problem is fairly obvious: The resistance between each grid and its cathode must be reduced to as low a figure as possible, so that the flow of grid current cannot develop any significant voltage drop to counter the applied signal.

LOW DC RESISTANCE

This just about obviates the use of resistance coupling and means that drive must be derived from a push-pull input transformer. What is more, the transformer secondary must itself have low DC resistance and no more turns than necessary to give adequate inductance.

A class B "driver" transformer usually has about unity ratio, primary: secondary, to ensure that the input impedance of the output stage is not reflected as an adverse loading on the driver stage. And,

DESIGNS PROBLEMS OF A "CLASS-B" MODULATOR



This circuit, intended as a class B modulator, was submitted to us by a reader for comment. Look at the circuit, read his letter below and see if you can pick where he's gone astray.

ourse, the driver must be capable f delivering audio power output, ith something to spare, over and bove what is required to drive the utput grids into grid current.

When we look at the circuit sug-ested by our correspondent P.D., is evident that it does everything ut satisfy these conditions.

The 807 grids are resistance-oupled to the preceding valve hrough quite ordinary values of oupling components. It would be mpossible to drive the grids sub-tantially positive, because they ould develop a counter-bias through heir return resistors.

In any case, the driver stage, be-ng a phase splitter, is quite in-apable of supplying significant out-ut power. It is, in fact, the very vorst type of driver one could visua-ise for such an application.

NOT FOR CLASS AB2

To be sure, we ourselves have used a phase splitter to feed 807 output valves but only in circuits intended for class AB operation, where there was never any intention of driving the grids to the point where they would draw current.

Then there's the matter of the bias. P.D. has shown the simplest method — a bias battery — the main difficulty being that it is connected into the wrong kind of grid circuit. as we've already explained.

Actually, batteries aren't so silly in such an application, even where everything else operates from a husky AC power supply. They deliver a steady and predictable bias and have a long shelf life. The only cur-rent that flows through them, as it happens, is a charging current, so that they tend to be reactivated whenever the modulator is in use.

Of course, if you don't like bat-teries, you can do as we have done on a few occasions. Get hold of a small transformer and a telephone type metal rectifier and feed its out-put in to a bleed resistor and a large filter capacitor. The circuit can be manipulated to give the right volt-age and the capacitor can be relied on to maintain a fairly steady bias with ordinary intermittent program peaks flowing in the grid circuit.

But it isn't practicable to use self-bias in a class-B output stage. With a low standing plate current, a very large value of resistor would be necessary to produce the requisite bias. Immediately the plate current started to rise, the bias would rise with it and the whole operation of the stage would be upset.

Self-bias just isn't a proposition.

When it comes to an actual figure for the bias voltage, we come up against another complication . . . 807 valves are not normally operat-ed in class B for audio service.

They may draw grid current and require driving with an input trans-former, just like a class B stage, but they are not biased back to the point of plate current cut-off. They are merely overbiased so that they draw much lower standing current than normal. With input signal, the aver-age current rises, once again preclud-ing the use of self-bias.

This mode of operation gives bet-ter linearity than class B with 807's and, in fact, with most pentodes and tetrodes. It is referred to in valve data sheets as "class AB2" operation.

These sheets indicate that the opti-mum bias for 807's in "class AB2" service lies between 28 and 35 volts, depending on the applied plate po-tential. The available power varies likewise between 55 watts with 400 volts applied and 120 watts with 750 volts applied.

CLASS B 807's

Actually, there is a class B con-dition for 807 valves which does not appear in many valve books. In this condition, the valve is con-nected as a triode, but with screen tied to grid rather than to plate. If memory serves me correctly, a resistor is connected in series with the grid to limit peak grid current, the composite grid arrangement operating with zero initial bias.

As might be imagined, the stand-ing plate current is quite low, since

LIMITING AUDIO POWER OUTPUT

Dear Sir:

I am studying for the AOCP examination and have found some of your articles over the past six months very informative and interesting.

Enclosed is a circuit of a modulator used to provide approx. 75 watts audio power to modulate a class "C" R/F amp.

In the attached circuit could you indicate the value of bias for modulator to operate in class "B", also whether this method of bias is correct ("C" or "B" battery) or if cathode bias would be more suitable?

In the modulation transformer primary if we have a nominal value of, say, 6900 ohms and working in class B at max. plate and screen voltages (and currents) we would obtain a power output of 120 watts (nominal). How would we calculate the ZP to provide the required 75 watts? Alternatively if the "plate to plate" load impedance of the 807's was unchanged and the voltage reduced to a value where the modulator output of 75 watts max. can be obtained, how would we calculate this voltage required?

Yours faithfully, P.D.

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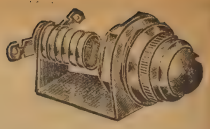

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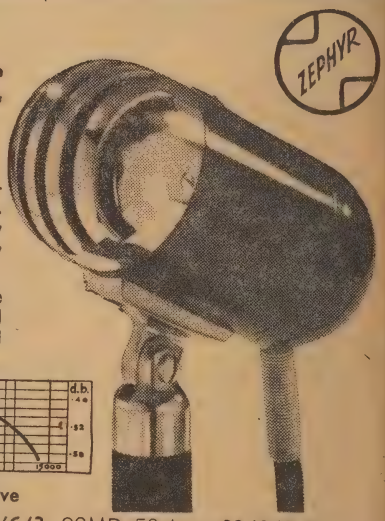

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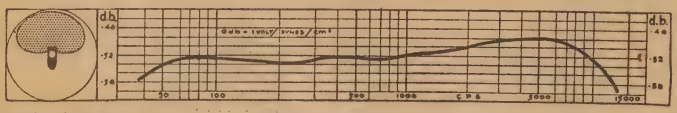

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valve in the static sense is really entode with no voltage on the en. I can recall quite a few arments over the air between the mpions of class AB2 tetrode and is B "triode" operation for 807's. fter all this, the answer to 's last question may come alit as an anti-climax. Here goes, vever:

ur correspondent wants to know at he can do to the load or the rating potentials to keep the ver output down to 75 watts. His parent intention, after allowing circuit losses &c., is to have t the right amount of power to dulate 100 watts of input to the te of his final RF amplifier. This y, he would avoid the pitfalls of ermodulation.

A very similar question often os up in our correspondence out domestic amplifiers. Readers ild a 10-watt amplifier for example, d find that they have to use it with peaker rated at say, 6 watts. "What ould I do to the amplifier," they k, "to ensure that the speaker will ver be overloaded?"

O CHANGES AT ALL

The answer to both P.D. and other ch amplifier constructors is the me . . . "It's unwise to make any anges to the amplifier at all. ou use it as it is."

If we examine the behavior of amplifier, it will be found that, the gain control is advanced from e fully "off" position, the power itput will at first rise quite noothly. In well-designed equipent, the distortion level may increase slowly with it but will remain quite low in actual percentge.

Once the power output reaches a ertain figure, however depending the applied voltages, output load nd so on, it will be found that any ttempt to increase it further is acompanied by a very steep rise in istortion level. This is defined as he "overload" region.

The amplifier will deliver more power, when pushed into overload, mind you, but only with a very high distortion content.

Now, by manipulating the load r the applied voltages, our friend .D. could arrange matters easily nough so that "overload" occurred n his modulator at 75 watts — but t wouldn't do him much good! It vouldn't prevent the modulator deivering 80 or 90 watts of distorted udio power to the transmitter on occasional speech peaks.

NOT A SAFEGUARD

It could not therefore provide an utomatic safeguard against overmodulation and, in fact, what overmodulation did occur would be the product of a distorted audio pattern. n Biblical language, the last state might easily be worse than the first.

Nor would it be a very good idea o reduce the non-distorted power imit of the modulator to say 50 watts. It might avoid actual carrier cutting but it would involve serious distortion on peaks if any attempt were made to approach 100 percent modulation.

The correct procedure is to use a modulator with reserve of power output but to set the gain control to a position where, with normal signal input, the peaks do not exceed 100 percent modulation.

This latter condition is best determined by means of a CRO or a modulation meter, although one can usually get fairly close to it by relying on the observation of fellow "hams" about the "weight" of voice and the presence or absence of "splatter".

Once having determined a suitable setting for the gain control and a suitable operating position for the microphone, one tends to use it automatically thereafter, without continuous reference to meters and things.

In the case of a domestic audio amplifier and speaker overload problems the position is not nearly so critical. There are no PMG inspectors waiting to nab you for causing "splatter" and speakers don't suddenly fall apart if their rating is exceeded.

Actually their power rating is a rather flexible thing, based as much

PROBLEM IN BATTERY SET DESIGN

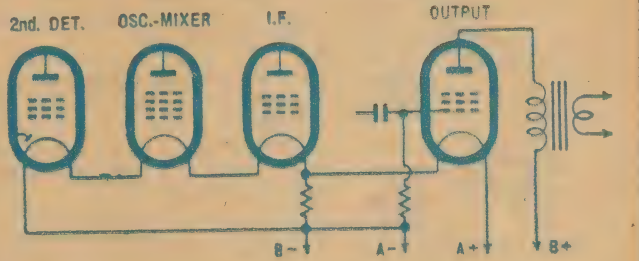
Dear Sir:

I wish to put forward the subject of the design of battery-operated radio receivers as a topic for discussion in "Let's Buy An Argument".

One point, in particular, I am interested in, namely, the bias source for the output valve in a series-connected 1.4V line-up.

With regard to this I quote from an article published on the subject in the April, 1947, issue of the New Zealand radio magazine, Radio And Electronics.

"Fig. 2 (the enclosed figure) illustrates a 1.4 volt receiver in which the tube filaments are connected in series for battery operation. The output filament is positive with respect to ground by an amount equal to the voltage drop across the other three filaments. This means that the control grid is negative with respect



to the filament by the same amount, and, accordingly, the output tube grid bias is proportional to the 'A' battery voltage. If the battery complement is so worked out that the 'A' battery voltage does not drop as rapidly as the 'B' battery voltage, the output valve will be over-biased at low 'B' voltage and an adequate power output cannot be maintained.

"On the other hand, if the 'A' battery voltage drops more rapidly than the 'B' voltage, excessive plate and screen currents will flow in the output tube and the result is short 'B' battery life."

As the extract above shows, the series-connected battery receiver suffers from the disadvantage that the life of the "B" battery is intimately dependent on the state of the "A" battery as well as the "B" battery itself.

Now in the "Rambler" Portable circuit (October, 1953, Radio and Hobbies), a type 739 9V battery is used for "A" supply and I estimate this to have a life of about, at the most, 60 hours. This is based on the relative size and number of the cells in this battery, as compared with the single D.950 cell (life 5 hours).

Two 482 45V batteries are used for the "B" supply and these have a life of about 200 hours (based on statement of their life capacity in the "Carry Set" Personal as 250 hours—in the October, 1949, issue of Radio and Hobbies). Hence, unless the "A" battery is replaced soon after its useful life is largely finished, insufficient biasing of the output tube created by low "A" battery voltage will cause more "B" battery current and a shortened life for the "B" battery.

I do not know whether this fact has been taken into account in the design of your 9V portable receivers. If it has, I would appreciate it if you could give measures which guard largely against the above effect recurring, such as:

(a) The effect is so small as to be negligible; e.g., if the 9V battery has an endpoint voltage of 6V, the "B" battery current is increased by some 3 mA—which I do not think negligible.

(b) Over-biasing the output valve in the first place so that when the "A" battery voltage falls, the tube has optimum rather than less than optimum bias.

I hope that you will comment on this point and on its possible effect on a 9V battery receiver.

Yours faithfully, G.D.J.

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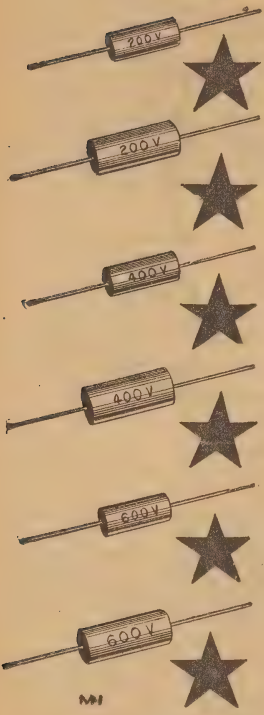

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on reasonable distortion content a on mechanical strength.

Once again, it isn't wise to limi the power of an audio amplifier t some deliberate figure to suit th speaker. It won't protect the speake from overload and it will only mea an overall degradation in perform ance. A 10-watt amplifier runnin to a peak power of 5.5 watts is in variably a better proposition than 6-watt amplifier doing the sam thing.

How then do you protect th speaker?

Simply by being sensible abou your demands upon it.

VERY LOUD

Any worthwhile speaker handlin 5 or 6 watts is going to be very lou in an ordinary house. Unless you'r a very extraordinary person with very extraordinary family, the vol ume control is never going to be ad vanced far enough to push the speak er to an average power of 6 watt: And, provided you don't do some thing silly, like combining a 30-wat amplifier with a light duty speaker it will never be in any great physica danger.

But, of course, there are people i existence who seem to hold rathe strange beliefs:

(1) The only good sound is a unbearably loud one.

(2) Bass should be heavily booste at all times and under all circum stances.

(3) Speakers don't really need goo baffles. You just make the cone worl harder.

(4) Living rooms should never b smaller than 40ft long by 30ft wide

Classes (1), (2) and (3) don' need a power limitation on thei amplifier; they need a good talkin to. If they still insist, well, a bigge speaker is the only answer.

Class (4) is no problem at all. Any one that can afford a room as bi as that shouldn't be fidding aroun with 6-watt speakers anyway! The can well afford something big enoug to fill their room with sound and d it with enough reserve on ratings t ensure minimum distortion.

What I set out to say and what repeat is simply this . . . you don' have to degrade the power rating o an amplifier to suit the speaker. Yo just recognise the capabilities of th speaker and regulate the gain con trol accordingly.

BIAS PROBLEM

Now for a rather abrupt change i subject matter. A reader from Nev Zealand wants to know what hap pens in certain types of portable se when the A-battery voltage drop more sharply than the B-batter voltage. Does the high tension cur rent rise to perhaps damaging pro portions?

In particular, what about a cer tain R & H circuit?

The query is based on quite vali grounds. These are stated in the let ter and there is no point in me re peating them all in detail. Sufficen to say that, in a portable set usin series filaments, the bias for the out put valve is usually equal to the volt age drop across the remaining fila ments.

When the set is designed, the volt ages and currents are balanced up t a nicety, to make sure that no fila ment is called upon to carry mor than its rated current. This ofte

lves a number of shunt resistors, h bleed off any surplus milli- s, due to the circulating high ion current.

he grid return circuits are care- y arranged to povide each valve l a suitable bias. Special atten- is paid to the output valve, se bias must be manipulated to e the best compromise between current the valve will draw and power output it will deliver to speaker.

his is all very well with new eries but what happens if the attery runs down faster than the attery? Doesn't the loss of bias the output valve upset all the ulations and allow the output e to draw high current with, per- s, a damaging effect on the life of B-battery?

ICAL CASE

rankly, we can't at this stage te figures for the "Rambler", we did check up on some other res which shed considerable light the problem. They show that the batteries do not suffer, for a rea- which our correspondent has arently overlooked.

When the filament voltage is low- d, the temperature and emission the filament is reduced with it. a natural result, the valves tend draw less current and it so hap- ns that one effect offsets the other y nicely.

Now I'm not suggesting that it's good thing to run valves with v filament voltage, or low plate ltage either, because their per- rmance suffers markedly. I'm rely making the point that, when is does happen, as it inevitably ll, no undue loading is imposed the B battery.

In a fairly typical set, using a 5-volt A supply and a 90-volt B pply, the current with an input gnal was measured at 12 milliamps. Reducing the filament supply volt- ge to 6.25, but leaving everything se the same, the current rose to milliamps, indicating to a minor gree the effect mentioned by our rrespondent. Note that this figure as for a full 90-volt supply where- , in fact, it would be reason- le to expect some degradation in gh tension voltage after running wn a filament battery. Thus the gure of 13 milliamps is likely to e on the high side.

A progressive reduction to 5.5 lts, however, showed a drop in gh tension current to 11.8 mA, indicating presumably that the loss of filament emission had more than offset the effect of reduced bias.

Readings with still lower filament voltages were of no significance, due to failure of the oscillator.

I can't guarantee that these figures would be duplicated in all portables, but there does not seem to be any reason why they cannot be accepted as quite typical.

It was interesting to note, by the way, that the maximum power output did not increase as the filament voltage was reduced. This seemed to indicate that any benefit derived from reducing the grid voltage from the original over-bias condition to normal was more than offset by loss of peak filament emission.

I don't think we've been caught out!

A large Vibratiton Machine

IN a recent issue of the NBS Technical News Bulletin, details are given of a new vibration machine which has been constructed at Boulder (Colorado) laboratories of the NBS. The machine has a load capacity of 20,000 pounds.

The machine was built at the request of the Air Force to study the behavior of heavy apparatus during rail and air shipment. The vibration table can produce double amplitudes ranging from 0.020 to 0.065 inch at frequencies up to 60 cycles per second.

Millions of dollars are spent annually to repair or replace apparatus that has been damaged or ruined in normal air or rail shipment. Small, lightweight equipment can usually be packaged in well-padded crates to protect it from damaging shocks and vibrations during transit.

However, it is generally much more difficult to protect large, heavy equipment in this fashion. As a result, many larger pieces of apparatus are shipped with no vibration protection at all or with inadequate, built-in shock mounts.

Several types of electro-dynamic systems were considered in designing the vibration machine. It was finally concluded that a mechanical vibration generator would be the most practical and reliable, in view of the large force output required by the Air Force and the moderate frequency range.

The type of vibration generator chosen uses the inertia reaction of unbalanced counter-rotating shafts to produce simple harmonic motion.

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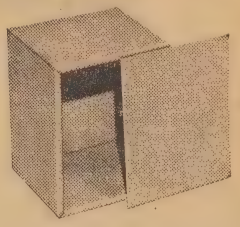

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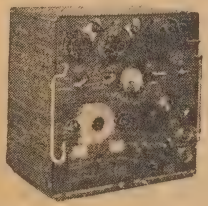

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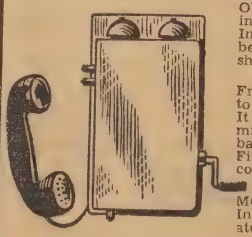

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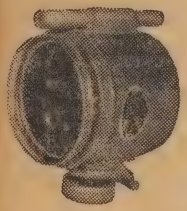

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OFF THE RECORD — NEWS & REVIEWS

Since the battle of the micro-grooves first began it was obvious to me, and I think to most observers, that the long playing feature was going to be the biggest puller of them all. This month Philips have released a disc which carries LP still further, and presents over an hour's music on a single disc. It might start a fashion.

by John Moyle

RAVEL—Daphnis and Chloe Suite No. 2, Rhapsodie Espagnole. STRAUSS—Till Eulenspiegel, Salome's Dance, Waltzes from Rosenkavalier. Played by the Cleveland Orchestra, conducted by Artur Rodinski. Philips A01134L.

This is probably the most interesting record of the month in that it represents perhaps the most developed example of the long playing record yet released in Australia.

The original is an American Columbia, and the makers claim that it contains twice as much music as the average LP disc.

It would, of course, be pretty unfair to hold them to this figure, because the amount of music on a disc is a far from fixed quantity. But without doubt it is a very long playing record, and, as far as the buyer is concerned, contains proportionately more music for his money.

The extra playing time is obtained by what is termed "superior grooving method".

Examined under the glass, this amounts to a most efficient system of micro-grading, under which the groove width seems to vary almost with individual grooves according to the amplitude of the cut. One can only admire the accuracy with which it has been achieved.

Contrary to expectations, there is no groove echo that I could notice.

But there does appear to be a decided reduction in dynamic range, as compared with a full high-fi recording. The effect is that all crescendos have been levelled off at a predetermined level, as indeed they would need to be if control over groove spacing is to be as accurate as in this record.

On the other hand, an almo silent surface has allowed enginee to record well down into the lo amplitude region, so that, except f the critical listener, the mus doesn't sound unduly compressed.

I would say that some attem has deliberately been made to ba ance frequency range to go with t reduced dynamics.

All the performances are good it would need half a page to tre them in detail!—and the orchestr tone is particularly bright and clea

For your radiogram, this looks very good buy indeed. Only the high fi fans might think it lacking a litt in zip!

CHOPIN—Sonata No. 2 in B Flat Minor, Opus 35, Sonata No. 3 in B Minor, Opus 58. Played by Guiomar Novaes. Vox PL7360.

Both performances are high-pres sure types, played most powerfully with great stress on dynamic con trasts.

If anything, I would say these ar somewhat overdone, particularly i the B minor sonata. It is customar to take some liberties with Chopir but in this sonata I feel there ar some passages which have bee rather fussily handled. Greater sim plicity would have enhanced th strong musical shape which other wise is quite successfully built up.

There are moments where some what slapdash playing has sacrificec clear articulation to the broade sweep of sound.

In the Funeral March sonata the pianist seemed to have a firmer con trol, although the same tendency to fly off into a splash of strong color is apparent at times.

These remarks are offered to indicate the type of performances found here rather than as points of strong criticism. They cannot hide the virtues of an otherwise good record.

The recording is quite equal to the full tone obtained from the piano, and heavy passages are handled remarkably well. There is no wooliness or tubbiness — on the contrary, it is if anything a little hard under pressure. The recording is at high amplitude, but there are no groove echoes which I could detect.

The surface is very quiet, only fractionally below the best. As a coupling of the two sonatas it might be hard to beat. It plays well with an EMI curve.

DVORAK—Symphony No. 2 in D Minor Opus 70 (Dvorak) played by the Hamburg Radio Symphony Orchestra conducted by Hans Schmidt-Isserstedt. Decca LXTA2807.

The immense popularity of the "New World" symphony has drawn attention away from the other fine symphonies of Dvorak, and this one is probably the best of them all.

There was a mix-up in the num-

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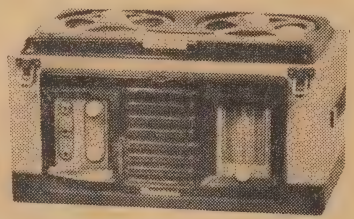

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ring of Dvorak's symphonies, and a series of nine, this one is actually seventh in order of composition. that it is not an early work as e might imagine.

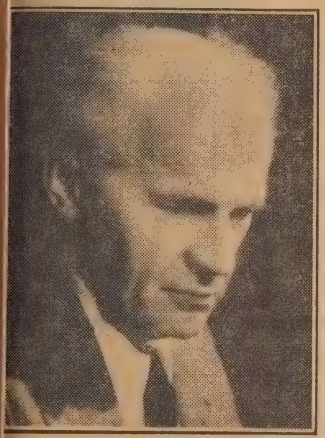
In character it is so like Brahms at it would be quite easy to fool yone who didn't know, at least til a second hearing, during which would be certain to become suscious.

I don't know why this similarity to ahms is so often the subject of ology among musical writers, for is so great that it could not possibly have been accidental.

I at least cannot help thinking in rms of Brahms rather than of vorak have been accidental.

It is a lovely work, and this record es it ample justice. So much so at I am content to leave it with u quite certain that you can't be sappointed.

The orchestra is in fine form, and ecca have achieved a mixture of oustics which is just right. It is ite a forward recording but the



Wilhelm Backhaus.

und holds together in just the way at Brahms—I mean Dvorak—eant it to.

The surface noise on my copy was ery low. It played successfully on e Decca curve, which has comaratively little top cut, without beng intrusive at any time.

As a record which succeeds in what it set out to do I'll give it five tars.

BEETHOVEN—Sonata No. 10 in G major, Sonata No. 22 in F major, Sonata No. 24 in F sharp major. SCHUMANN—Warum. Played by Wilhelm Backhaus. Decca LXTA2931.

I cannot persuade myself that this ecord is up to the best requirements f the day.

It's not so much the performances hich disappoint me as the recordng. It has all the earmarks of having een made several years ago, before ngineers had learned to overcome he difficulties of keeping piano tone lean and free from distress when nder pressure.

Almost every loud passage on this isc shows deterioration of tone, hich would condemn it for hi-fidelty machines, where such things can't e tolerated, or at least only under xtreme provocation.

Whether the record is worth the provocation is a matter of opinion. Neither of the sonatas is a Beethoven highlight, although they are quite important to we lesser lights of the piano.

Backhaus finds no technical or emotional difficulties with them, and plays them that way.

Easily the best music on the disc is the F sharp major Sonata. Not only is it recorded at a noticeably lower level, which, although it adds remoteness to the piano, at least cleans up its recorded tone, but the pianist himself seems to show his greatest interest.

But even here I could not rate the record as better than fair average. It should be played with an EMI curve.

The best thing about it—Backhaus himself.

VAUGHAN WILLIAMS—Fantasia on a Theme by Thomas Tallis. BENJAMIN BRITTEN—Variations on a Theme of Frank Bridge. Played by the Philharmonia Orchestra conducted by Herbert von Karajan. Columbia 330CX1159.

A splendid coupling of two works often considered to represent the best of both Vaughan Williams and of Britten.

The Fantasia was first performed in 1910, after which it was reduced in length to the version now often heard at concerts, and used in this recording.

To the listener it is overwhelmingly a study in pure sound, romantic and austere, built into mountains and fined down to the merest wisp or the echo of a wisp.

It is scored for strings only, with two separate sections, one of nine players and another of four.

Britten wrote his variations for Boyd Neel's orchestra in the record time of about six weeks so that they could be performed at Salzburg in 1937.

The musical score is mostly a brilliant satire under headings such as "Aria Italiana", in which the vocal caperings of the traditional coloratura soprano are burlesqued, and "Romance", a parody of a ballroom waltz a century ago.

There isn't much edge to the humor, and Britten mostly succeeds in drawing attention away from the subject to his own fresh and enterprising technique.

Both works require a recording which catches the full body and weight of the strings, and which has more than average dynamic range to portray successfully the many contrasts in volume.

In these things the new release is markedly successful. My main criticism is that the surface noise is too high to be quite lost in the soft passages unless the EMI curve plus a little extra top cut is used. In the Tallis, particularly, surface noise just can't be tolerated.

I liked the well rounded bass on both sides, and the general string tone and balance, which are always warm and convincing.

A good disc.

BEETHOVEN — String Quartet No. 7 in F major Opus 59. No. 1 Played by the Italian Quartet. Decca LXTA2856.

Here is a Quartet of a remarkably high standard, one which exhibits team work as fine as I have heard on records in recent years.

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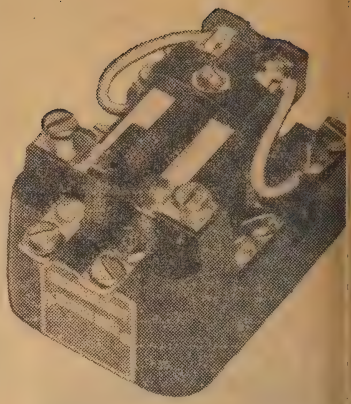

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ult its technical standard, either dividually or as an ensemble.

It would not be hard to believe at the players communicated by me kind of mental telepathy, hich, if it comes to that, might be arer the truth than is generally agined.

At any rate they make some of the veliest sounds I have heard from ur strings.

It may be fortunate that this quar- t does not need as much mental rcefulness and power as some of ose coming after it. It could be at greater ruggedness and deeper sight might be needed to cope with ethoven's later work.

But here at least the Italian Quar- t gives us a record which I found ntirely delightful.

Occasionally the tone tended to come a little thin, as though con- ntration on distinguished style as becoming more important than e music.

I began to wonder whether this uartet would ever really let its air down.

At the same time I could only mire the beautiful way, for in- ance, in which the little dialogue as handled in the second move- ent, and how clearly the tone ality of each instrument was derlined.

The recording is a very fine one. has just enough presence, no tra-sharp edges to the first violin, d yet with plenty of clean pre- sion about the attack. It played rfectly well on the Decca setting a tribute to the surface.

If there is a better recording of is quartet I don't know it. On a tal count it will be hard to beat.

WAGNER — Rienzi Overture, Wotan's Farewell and the Magic Fire Music. Played by the New York Philharmonic Symphony Orchestra, conducted by Leopold Stokowski. Columbia 330C1026.

Rienzi was one of Stokowski's ar pieces in the early days of elec- ical recording and will stand out the minds of early gramophone idicts as a powerful highlight of und.

His version today is just as power- l, just as resonant, and just as eatrical. To him it is a splendid ehicle to show what he can wring om a big orchestra, and you will rtainly go for it on that ground one.

But I find this virtuoso posturing ither unsatisfying musically. Every imax is preceded by an appropriate ip in emotional tension in order at the full peak may be reached, very swirl of sound and instru- ental color streak is shaped and rojected so that musical sincerity quite subordinated.

Rienzi can stand this treatment etter than Wotan's Farewell and the lagic Fire Music. Here there is no uestion that the orchestral part has een used purely as the means to xhibit the technique I have been iscussing. There is no soloist.

Technically the record has caught he orchestra's resonance and weight uite well. I thought the recording ather too forward to sustain the otal sound, and the exaggerated ynamics accentuate an impression f lumpiness. But without doubt, if is Stokowski you are after, this it.

The surface is only fair, but a high mplitude cut renders it virtually audible.

BORODIN — String Quartet No. 1 in A major; played by the Vienna Konzerthaus Quartet. Westminster WL5305.

The most famous piece of chamber music by Borodin, one of the Russian Big Five of the last century, is undoubtedly the slow movement from his second string quartet.

But his first quartet is on the whole a more even and satisfying work. Although it was allegedly inspired by a musical phrase from Beethoven's Opus 130 it has nothing in common with Beethoven's style or line of thought.

It is a richly melodious work, fully scored in a way that gives it quite an orchestral flavor. Borodin was a 'cellist (as well as a physician) and it is perhaps the importance of the cello part which imparts such body to the music.

The recording is extremely forward and vivid, as is normal with Westminster's chamber records. This throws emphasis on the sharp string edge which, although it may be authentic, sounds best with a NAB curve. This is not mentioned on the cover, as is often the case with Westminster.

The recording realism is particularly evident in the Scherzo middle section, where harmonics are freely used. Obvious, too, is the tape break at the commencement of the trio, where, on wide range equipment, the stop and start of tape noise can be heard. Not really a blemish—just one of those things the ear picks out.

The pressing appears to be a good one—there is no obvious deterioration of tone or variation between sides. The surface noise is the merest rustle, and blemishes are few. A most musical and gratifying disc, well rounded and technically first-rate.

LISZT—Concerto No. 1 in E flat major, Concerto No. 2 in A major. Played by Cor de Groot with the Radio Philharmonic Orchestra (Hilversum) and the Residency Orchestra (The Hague). Conducted by Willem van Otterloo. Philips A00200L.

Cor de Groot is a pianist who always turns out a good record, and even if he doesn't score a clear winner over the complete field he can always be relied upon to do well from Beethoven to Rachmaninoff.

In this record he shows that technically he can handle everything that comes along with clean and deft finger work, although he doesn't show the devil that is needed to make these flashing passages whip away.

One simply cannot play Liszt and be nice about it. Liszt had no inhibitions either in his brilliance or his sentiment, and a first-rate exponent of these concertos can't afford to have them, either.

A good comparative example of what I mean is found if you can play Edith Farnadi's earlier recording for Westminster. There really is a big difference between her approach and that of de Groot.

In the orchestral playing, too, I'm afraid the comparison would be much the same. Particularly in the A major, the Philips disc sounds rather tame after the immense vitality of Westminster's Vienna players.

I thought the E flat major concerto the better of the two on all counts. The recording is better than on the reverse side from the very first note, and both the soloist and the orchestra find the spirit of the music much more adequately. There is some good playing on this side.

The surface is smooth and the orchestral tone has plenty of warmth.

The record plays well with the EMI curve.

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HANDEL — Concerti Grossi Opus 6, Nos. 1, 2, 6 and 7. Played by the Vienna Symphony Orchestra conducted by John Pritchard. Philips AOO-235L.

This is a record which must be recommended most highly. Of all those received in the last few weeks I have returned to it most often as an outstandingly fine piece of work on every count.

Its main virtue I think lies in its overall balance. It isn't a hi-fi disc in the sense that there are ear-tickling jingles or thunderous bass. It just isn't that kind of music, and there has been no attempt to achieve technical glamor.

These beautiful works, four from a set of twelve which make up the Opus 6, represent some of Handel's finest music. The form provides for a Ripieno, the main orchestra, and the Concertino, a smaller group of strings, often with a harpsichord. These two sections work out the musical texture in combination and contrast, the Concertino often being heard by itself, as we hear it in these four Concertos.

Under the leadership of John Pritchard, who has done such fine work with the Vienna Orchestra, care has been taken to reproduce a band of players near to that used in Handel's time remembering the somewhat different instrumental timbre of today.

This beautiful sense of balance to which I have referred stems largely from this, and also from the well-judged orchestral placement—forward enough to keep the intimacy of a small group and sufficiently remote to sustain the sound as should be done.

The harpsichord is possibly the only instrument which seems to be overshadowed at times, a fact which is hinted at on the excellent cover notes which tell the story of the music and the form in which it is written. A few scrapy violin notes are the only bows from grace I feel like mentioning.

The surface noise is quite inaudible even in the quieter passages.

This is a beautiful disc—one you shouldn't miss.

GRIEG — Lyric Suite. EMIL REESEN—Himmerland, Danish Rhapsody. Played by the Danish State Radio Symphony Orchestra conducted by Erik Tuxen and Emil Reesen. Decca LXA3125.

Grieg's Lyric Suite isn't as well known as the Peer Gynt Suites, but has the same flavor and charm. It is based on arrangements by Anton Seidl of some piano pieces, and was later edited by Grieg and published in its present form.

Emil Reesen is a Danish composer, and his Rhapsody is little more than a free arrangement of folk tunes which, although quite different from the Grieg, are appropriately grouped on the other side of the record.

Both performances and recording are extremely pleasant. Although the orchestra doesn't sound big, it achieves an appropriate intimacy which goes well with the music. This is one of those records which make up the background of a disc library, and do it completely and well.

Frequency range is quite wide, although a higher-than-normal surface noise makes the EMI curve best to use. There is also some occasional pre-echo to be heard where the variable grooving—freely used all the way—seems to hae got a bit out of step.

MOZART—Concerto No. 24 in C Minor, No. 26 in D major for piano and orchestra. Played by Robert Casadesus and the Columbia Symphony Orchestra conducted by George Szell. Phillips AO11421.

A recently released recording of Mozart's Concerto No. 27 on another label left me very disappointed. I liked neither the playing nor the recording.

But this one of Nos. 24 and 26 is a very different proposition.

Casadesus still shows a tendency to miniaturise the music more than I feel is necessary. These concertos are far from the dainty bits of thin we can find in Mozart, and in which mould musicians often try to cram him.

But Casadesus shows that he has strength, too, when the music calls for it.

The C Minor is generally regarded as one of Mozart's best, and is better known than No. 26 major.

It was the C minor of which Beethoven is reported to have said to his pupil Ries (surely one of the most famous musical pupils!) "My dear fellow we shall never get an idea like this."

Whether we agree with those sentiments or not, there is a thread running through this concerto, in company with a few others, which bind Mozart to Beethoven, and which give it special worth.

The recording is not particularly forward, and there is a little extra reverberation which I found quite pleasant. In fact both these works I think are big enough to stand some amplification in size and weight. But if Casadesus tends to keep them down to size, he does it with polish and distinction.

It is a record which will play cleanly and sound well on any equipment.

RACHMANINOFF — Concerto No. 2 in C Minor. Played by Edith Farnadi and the Vienna State Opera Orchestra conducted by Hermann Scherchen. Westminster WL5193.

Rachmaninoff showed us exactly how this concerto should be played when he made a set of records for HMV in the early electric days.

What a tragedy it was that they are so poor now by modern standards! Only by the use of every scratch filtering dodge can they be played with much pleasure.

And yet they stand out in my mind as a unique example of composer playing his own work in a manner which has never been equalled.

In fact there are plenty of people who seem to go out of their way to make the music sound fundamentally different from the way Rachmaninoff gave it out.

He saw the piano as something homogenous with the orchestra, to sing with it, to be drowned in it and to emerge from the surge of sound with its own voice as a complement to the instrumental color

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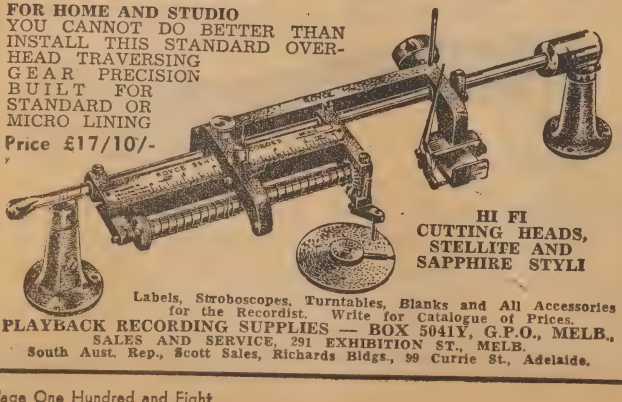

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he used with such a glowing hand. Hence my quarrel with this otherwise excellent disc. The music is played very slowly and analytically, very clearly and with full musical exposure.

Edith Farnadi's undoubted talents are brought to the fore and kept to the fore. The orchestra comes off a valiant second.

If, however, you don't see eye to eye with me about the way it should be played, you will certainly like this record, for its sound is typically Westminster's vivid, powerful, and most impressive.

The piano is a fraction tubby in the lower register, and there is some difference of opinion about time once or twice between the piano and orchestra, but otherwise the performance is high class. Maybe it was Sherchen who was

Julius Katchen

responsible for the very slow tempo. Edith Farnadi on the other hand is generally in a hurry.

The surface is quiet, although one side had a slight swish. It may well be the best Rachmaninoff to date.

BEETHOVEN — Thirty-three Variation on a Waltz by Diabelli. Played by Julius Katchen, pianist. Decca LXTA 2804.

Any young man who can tackle these variations with an authority and imagination as shown here by Katchen can be assured of a high place among modern pianists.

Beethoven was possibly the greatest master of variations. This set is truly music for pianists. Its extraordinary mental and technical range will leave all but the top grade laboring in indecision, and failure to bind the many and varied moods together into their full and completed shape.

Katchen's approach is undeniably youthful. It would be a mistake to look here for the performance of Schnabel, simply because he is not Schnabel, and will probably never achieve a similar musical outlook.

He will undoubtedly develop further maturity which will enable him to see more in this music. But even if he does, the merit of this performance will remain as a delight to hear for a long time to come.

This is top line Beethoven. It is also top line recording. Together these give Decca a distinguished record which every serious record buyer should have.

Space simply does not allow me to say more.

MENDELSSOHN — Symphony No. 3 in A Minor Opus 56 (Scotch). Played by the Sydney Symphony Orchestra conducted by Eugene Goossens. HMV OBLP1045.

Viewing this disc impersonally, and free from the sentiment which goes with a local recording, it would fall into the class of a good stock performance, with the usual mixture of fair, average and very good playing.

I retain the impression that everything is done very carefully—an impression which was made when hearing earlier releases of this recording batch. Incidently it is one of a number made in the Great Hall of the Sydney University two or three years ago.

I have a soft spot for the music, particularly for the first movement, in which so much joyousness is to be found.

But the orchestra doesn't often catch this joyful mood, or for that matter show any great life at all. One reason seems to be a curiously restricted dynamic range which has ironed out the contrasts between loud and soft in a manner I'm sure Goossens didn't intend. This effect is particularly noticeable in the second movement where light and shade can be used to much better effect.

The orchestra compares with many but not with the best. It hasn't the smoothness and relaxation we expect from top-liners. Often the impression was that the players were "flat out" where in fact they should not have been extended.

But for all that it is a pleasant disc, and well worth your hearing as a 10-inch proposition.

The surface is quiet, and it plays well on the EMI curve. There is no serious reason why it should not be well received.

BEETHOVEN — Symphony No. 2 in D major Opus 38. Played by the Concertgebouw Orchestra conducted by Eduard van Beinum. Philips AOO720.

A particularly well-balanced performance, no affectations, no mannerisms, no exaggerations of speed or dynamics.

I liked the tightness of the playing which is particularly evident in the first movement.

In his handling, particularly of the strings, van Beinum reminds one very strongly of Toscanini in this record.

On more than one occasion the thought was borne on me—that's the way Toscanini would have done it.

I liked particularly the pace with which each movement is played. In this respect I thought the record better than the HMV disc of the Sydney Orchestra, in which Goossens, to my mind, takes both the second and third movements too slowly.

The Scherzo under van Beinum is delightfully done, and he follows it with a bright and well shaped finale which leaves us with an appropriate feeling of well-being.

The recording isn't as forward as

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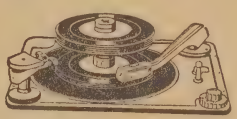

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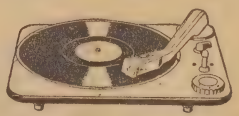

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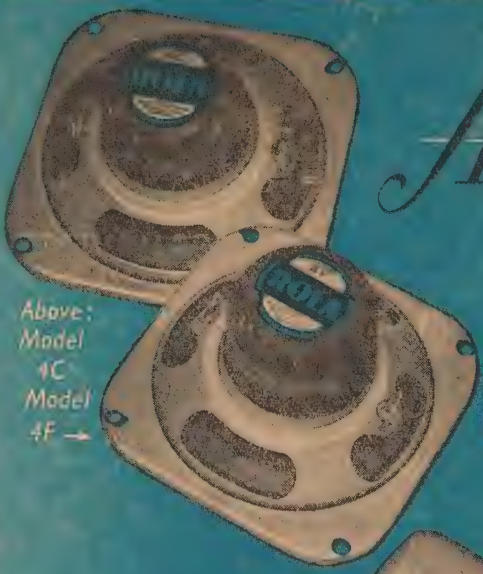

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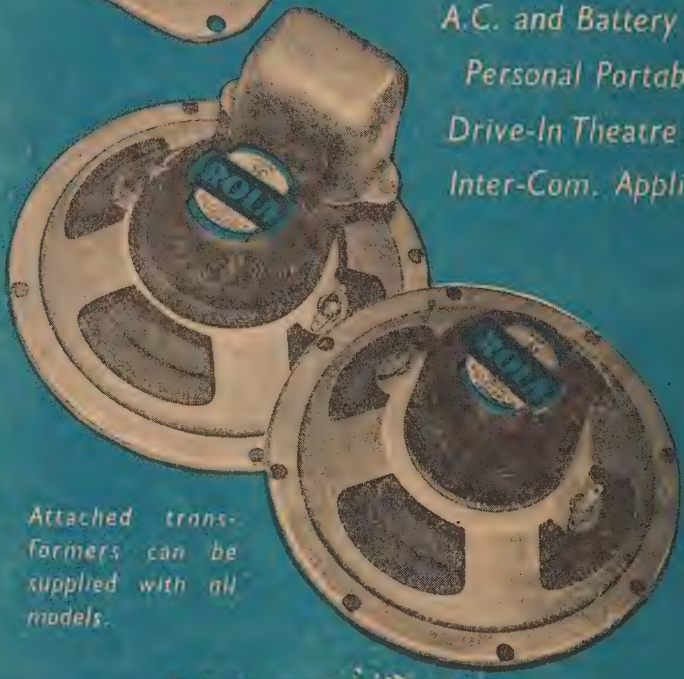

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hat of Goossens (nor is the inner rchestra as clear) and the ampli- ude isn't as great. Whether this as helped to get it all on a 10- nch disc I don't know, but at all vents it's there.

Which brings me to the only thing don't like about it—a split in the econd movement.

It seems ironic that I should have uch a complaint in the same issue s that which compliments Philips n its ultra-long player.

I wonder whether the extra few hillings would really weigh against break which carried me horribly ack to memories of the 78 days, nd at that same spot, if I am not nistaken, where the discs used to plit?

The surface is good. The EMI urve is recommended.

MUSIC FOR ZITHER AND CIMBALOM—played by Ruth Welcome and Dick Marta. Cook-Nixa SLPY149.

The recording is wholly admir- able. It's only flaw is something which seems to appear on many Cook records—a surface and tape noise which, although not really prominent, is enough to spoil the complete sense of realism which otherwise would be of the highest order.

There is also a faint hum, again possibly from the recorder, which wide range machines will pick up if played with the AES curve, for in- stance, without any bass roll-off.

I mention these points because the vivid impact of the recording is such that one tends to turn up the gain to make the most of it.

These are true "Sounds of our Times" records, and will appeal mostly to those who have an interest in these charming and little known instruments. Hi-fi fans and music- ally inclined people will welcome them.

Both players are fortunate in that there is little competition, but to me, at least they appear to be first- class peformers. The items are too numerous to list, but are eleven all told, and their range is wide.

REGINALD FOORT PLAYS—Mendelssohn Scherzo in E minor, Grieg's "To the Spring", Prelude to Act 3 of Lohengrin, In a Monastery Garden, Light Cavalry, Wipe, Women and Song, Anvil Chorus. Played on the Mosque Theatre Organ. Cook-Nixa SLPY148.

As a recording of the theatre organ I'll pay this one to Messrs. Cook and Foort.

Its got much more atmosphere about it than most of its type. Although there is some very low bass, which can stand a little boost if you want really to hear it, it isn't as spectacular in this regard as the Bach record I have mentioned pre- viously. But it certainly has weight.

Nor to my mind do things like the Scherzo and "To the Spring" go very well on this type of organ, but then in a theatre anything goes for those who like it. I find the tendency to play every selection with the same general registration very monotonous.

It will sound most realistic if your gear is good.

The surface noise, mostly on the tape, is higher than I would like.

MASCAGNI — Cavalleria Rust- icana, starring Mario del Mon- aco as Turiddu and Elena Nic- olai as Santuzza. Chorus and Orchestra conducted by Franco Ghione. Decca LXTA2928-2929.

Few operas have been as success- ful as this one-act drama of love, betrayal and death in the hot- blooded clime of Sicily.

It is important in the history of opera as virtually the first of the short opera-dramas. But few rival it in public acceptance.

Compared with conventional full- length opera, some of which are miracles of complicated narrative, it has the impact of a short story as against a novel in the economy of its characterisation and action.

SIMPLE STORY

It is the story of Santuzza, the girl betrayed by Turiddu, a handsome rascal who, spurning her for the wife of another villager, is chal- lenged to a duel by the wronged husband, and stabbed to death with a stiletto.

Almost throughout it is played in a high emotional key, with no relief in its march to the climax.

It is inevitable, therefore, that there should be many torrid vocal moments, but the two principals here tear themselves to tatters in what, at times, sounds periolously close to a straight out bawling match.

Mario del Monaco, who I believe is largely self-taught with the aid of gramophone records, is a tremend- ous tenor, with a vitality and per- sonality well suited to his part.

Elena Nicolai matches him with her big, rich voice, and the strength of her emotional reactions.

UNEVEN VOICE

Unfortunately her voice goes to pieces at anything less than a double-forte. Her portrayal of emotion in a low key degenerates into an impassioned vibrato in which the pitch is almost entirely lost.

Her heart-broken sobs have such force that one could imagine her beating up her erstwhile lover rather than pleading with him to return.

Del Monaco, too, seems unhappy unless he is standing off and using his full lung power.

After an hour of this treatment, the audience—in this case me—suffers from extreme aural ex- haustion.

The supporting singers are just average.

And yet, apart from these obvious flaws which must be recorded, there is little doubt that the passion and violence of the story would be out- raged by any hint of prettiness in the principals.

But it should be possible to handle this high powered emotion with more subtlety and less amplitude.

The orchestra plays really well. The recording handles the severe groove echo where strong voices are interpolated into a quiet orchestral background.

The surface noise is very low, but heavens; it hasn't a look-in most of the time.

A recital by del Monaco of oper- atic excerpts on the odd side con- firms the general impression given in the opera, although some of the numbers show that his rather ex- travagant voice is capable of greater range and expression.

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SHORT-WAVE NOTES BY ART CUSHEN

SAO PAULO IS ACTIVE ON 49 METRES

Five transmitters located in Sao Paulo, Brazil are providing good signals in the afternoons on 49 metres.

SAO PAULO, located inland from the capital, Rio de Janeiro, is claimed to be the fastest growing city in the world. In the past 10 years it has added over 1-million in population.

Recently we heard five new transmitters in this city, all at 2 pm or later (1 am in Sao Paulo), while one station has been using English identification.

RADIO NACIONAL

The new Government-operated Radio Nacional which we reported recently on 15170 Kc at noon has been heard on 6120 Kc to sign off at 3 pm. On Sundays sign off is at 3.15 pm.

The station has been heard with relays of the key station Radio Nacional in Rio de Janeiro. The programs consist of Portuguese dance numbers, with news at 2.45 pm and sign off at 3 pm. On Sundays the news is presented after time signal at 3 pm, the station closing at 3.13 pm.

RADIO CULTURA

The strongest signal of the Brazilian transmitters is that of ZYR58, Radio Cultura, which operates on 6165 Kc.

The excellent transmissions from this station are spoilt at 2.15 when the Swiss transmitter HER3 beamed to North America commences operation.

ZYR58 has been heard to announce at 2.05 pm as "This is Brazil calling. You are tuned to Radio Cultura, located in Sao Paulo, the fastest growing city in the world."

They then present a program called "Twilight Music" and normally close at 3 pm but at times have been heard later at which time they are free from the Swiss interference.

NEWS on readers activities should be sent to 212 Earn Street, Invercargill, NZ.
All times are Eastern Australian Standard.

JOZ3 on 9595kc

THE Nippon Short Wave Broadcasting Company, Tokio, mentioned in a recent issue as being well received on JOZ 9595 Kc, has added a third transmitter JOZ3 on 9595 Kc.

This short wave commercial station tested last June on 3925 and 6055 Kc using the calls JJ2KY and JJ2KZ, and after the experimental broadcasts, from August as JOZ and JOZ2. The full schedule provides JOZ (3925) and JOZ2 (6055) from 7.30 am to midnight and JOZ3 (9595) from 2 am to 8 pm. All stations carry a news broadcast in English at 7.50 pm.

THE well-known Bogota transmitter, Radio Sutatenza station on 5075 Kc has been given the new call sign HJGC in place of its old call sign of HJKH. A new transmitter on 3250 Kc was first noted by S. R. Morris, Ashburton, Vic., who passed on the news of his reception of this new relay station. World Radio Handbook gives the network of Radio Sutatenza as HJGP (1580), 250w, HJGO (3250), 10Kw, HJGC (5075), 25Kw, operating 8.50-9.45 pm, 5.50 am-12.40 pm. Verification is by card and our confirmation for HJKH was signed by the Technical Secretary.

RADIO EXCELSIOR

Using the new frequency of 5960 Kc the transmission of Radio Excelsior are heard at weak strength. The station is assigned 6125 Kc, but due to the operations of Radio Nacional on 6120 Kc it appears to have been forced to make this frequency change.

Signals are first heard after 12.30 pm when Lisbon, using the channel to South America, signs off. The program of Portuguese dance music is concluded at 2 pm.

Then follows news highlights, and the station closes using the theme "Concerto for Two".

The two other stations providing fair reception are ZYB7 and PRD21. ZBY7 Radio Difusora Sao Paulo on 6095 Kc is a regular winter signal, and broadcasts of sports relays are a feature of the broadcasts on Sundays, until after 2 pm. Signals are at times good, but Australian listeners may be troubled with side interference from VL16 6090 Kc.

PRD21 operating on 6195 Kc has been noted at times—at 2 pm with interference from HJCT in Bogota on 6200 Kc. PRD21 uses the slogan "Emisora Continental" and uses 7500 W.

This Radio Age

THE popular session, This Radio Age, has been retimed, and is now broadcast by Radio New Zealand, on the first Wednesday of each month at 7.20 pm.

In the latest broadcast, the compere Cleve Costello, visited the monitoring station of the New Zealand Broadcasting Service at Makara, outside Wellington.

At Makara as well as monitoring BBC news broadcasts for rebroadcasting over the Home Service Network, checks are made for many other broadcasting organisations.

MULTI-LINGUAL BROADCASTING FROM ADEN

THE small British Colony of Aden is the latest country to be reported on short wave, but transmissions from this country were first heard by the writer in 1941, under the call-sign ZNR, using 250 watts on 12112 Kc. The new Aden transmission which has been operated on low power for the past year, is broadcasting a programme in Arabic, and a Forces service in English, according to the World Radio Handbook. Aden operates the Aden Broadcasting Service on 1025 Kc, 300W, and 6050 Kc, 3500W. The short wave transmitter is on the air from 1.30-3.30 am in Arabic, on 1025 Kc from 1.30-2.45 am (Arabic) and with the Aden Forces Broadcasting Association from 2.45-5.30 am in English.

FLASHES FROM EVERYWHERE

DUTCH NEW GUINEA'S service [illegible] Hollandia now operates two transmitt[illegible] reports the ISWC. Radio Omrep, N[illegible] Guinea, broadcasts on 5045 and 3345 [illegible] from 7 pm to 10.30 pm on Monday to Frid[illegible] 10.30 am to 11.30 am on 7126 Kc Sat[illegible] days, 1.00-3.30 pm, and Sunday 9.30 [illegible] to 2.30 pm on 7126 Kc.

The new 5000 watt transmitter on [illegible] island of Biak will commence operat[illegible] on October 1st, 1955.

ARGENTINA, the scene of a rec[illegible] unsuccessful revolt, saw the destruct[illegible] of the Government Radio, Del Estado, [illegible] 9690 Kc. It has not been heard by Eu[illegible] pean listeners, who report that it [illegible] bombed on June 16. LRY, Radio E[illegible] grano, in the capital, Buenos Aires, [illegible] been noted in Europe at 6.30 am [illegible] 15345 Kc.

HAITI'S 4VEH, at present operat[illegible] on 9639 Kc from Cap Haitian, has ado[illegible] a new 1000 watt transmitter in the [illegible] metre band, on a frequency of 6100 [illegible] using the call sign 4VEA. They sign [illegible] at 8.30 pm and sign-off at 1 pm on b[illegible] frequencies.

The station plans shortly to open [illegible] the 19 metre band with a 10,000 w[illegible] transmitter, and the call sign of 4V[illegible]

CANADA'S lowest powered CBC sh[illegible] wave transmitter, using 150 watts [illegible] 6160 Kc, has been heard at 4 pm w[illegible] the identification "This is CBU and sh[illegible] wave CBUX broadcasting from V[illegible] couver." Signals are only fair, [illegible] when the Berne transmitter HER3 op[illegible] at 4 pm in their European Service int[illegible] ference is too strong for CBUX.

CANADA'S Dominion Observatory [illegible] Ottawa has been heard by several re[illegible] ers, operating on 7330 Kc, with 3000 wa[illegible] The station is assigned CHU. The stat[illegible] transmits a second tick from the Obs[illegible] vatory, and each minute the station gi[illegible] voice announcements such as "This [illegible] the Dominon Observatory. Eastern St[illegible] dard Time is zero hours, ten m[illegible] utes." Signals are best at 4 pm and [illegible] transmissions are beside that of Mo[illegible] Carlo which runs at 4 pm on 7345 [illegible] CHU also operates two further tra[illegible] mitters on 3330 and 14670 Kc, both us[illegible] 300 W and audible.

ALL INDIA RADIO has embarked [illegible] a very extensive building program [illegible] we reported recently, and further inf[illegible] mation on new stations has been bro[illegible] cast by Radio Australia.

A new 25 Kw transmitter at Simla [illegible] been completed and is reported now [illegible] operation. Two 1100 Kw transmitters [illegible] being built at Bombay and Madras, wh[illegible] a new site is being prepared at De[illegible] for a further two Kw transmitter. [illegible] other new station at Gauhati will a[illegible] operate on short wave and use 10 K[illegible] and operate in the East Regional serv[illegible] with Calcutta as key station.

LEOPOLDVILLE, home of OTC a[illegible] Radio Congo Belge, has been heard wh[illegible] the latter transmitter has been logg[illegible] on the new frequency of 9480 Kc. Tra[illegible] mission on Monday closes at 8 am af[illegible] an hour of uninterrupted dance mus[illegible] Transmissions close at 8 pm with [illegible] Belgian National Anthem.

NORTH VIETNAM'S transmitter [illegible] Hanoi, calling itself The Voice of Vi[illegible] man as does the South Vietnam stati[illegible] at Saigon, now broadcasts a session [illegible] news in English at 11 pm daily. T[illegible] station uses 9925 and 11995 Kc.

SURINAM, the Dutch colony on t[illegible] South American continent, has be[illegible] logged by a New Zealand reader, I[illegible] Collett, on the new frequency of 4742 K[illegible] using the call PZH5. Located at Perne[illegible] banco, the station signs on with chim[illegible] and after a musical program and at 7.50 p[illegible] has news in Dutch. The frequency [illegible] places 5752 Kc and opens at 7.30 pm [illegible] fair strength though aircraft transmissio[illegible] are at times troublesome.

THE HAM BANDS WITH BILL MOORE

The Remembrance Day Contest is conducted by the Wireless Institute of Australia and since 1948 has been held annually in memory of radio amateurs who fell in World War II.

? is conducted on the weekend nearest the anniversary of VP Day, August 15. is held to perpetuate the memory of stralian radio amateurs who gave their es for their country in World War II.

Their names and call signs are engraved the trophy which is awarded annually the Division of the WIA whose leading mpetitors compile the highest score. Amateurs throughout the Commonwealth e especially invited by the WIA to par- ipate in the contest. The rules are follows:—

1. The contest will commence at 1800 urs East on 13th August and continue rough until 1759 hours on 14th August.
2. The contest is open to all Australian nateurs, but only members of the WIA e eligible for awards.
3. The contest is an open event—CW, one or a combination of both may be ed.
4. The contest is an Interstate contest, d amateurs in each State will endea- r to contact amateurs in all other ates.
5. A station may be operated by more an one operator under the station call gn provided that operators other than e station licensee submit a separate log nder their own call signs for contest rposes.

MULTI-OPERATOR RULES

To implement this rule, the following ocedure shall be adopted by all licen- ees other than owners of the station con- rned:—

A. Licensees operating stations other an their own shall, for the purpose of ese rules, be hereinafter referred to as ubstitute operators".

B. Phone contacts: Substitute operators ill call "CQ Remembrance Day" follow- d by the call sign of the station they are perating and the word "log" followed by eir own call sign.

C. CW Stations: Substitute operators ill call "CQ RD de" followed by a group ll sign comprising the call sign of the ation they are operating, an oblique roke and their own call sign.

D. Receiving Contestants: Contestants eceiving signals from substitute operators ill qualify for points by recording the ll sign of the substitute operator only, .e. the last call sign).

E. Nothing in A, B or C above, will pre- lude the station licensee from participa- ng in the contest himself, providing he ubmits a separate log under his own call gn.

6. All existing amateur bands may be sed and all transmissions must conform ith the regulations as laid down in the MG's "Handbook for the Guidance of perators of Amateur Wireless Stations" ny breaches of these will lead to the isqualification of the operator concerned.

7. The arrangements of schedules for ontacts on other bands will not be per- itted.

CALL "CQ-RD"

8. All stations entering the contest will all "CQ RD" if using CW and "CQ Re- embrance Day" if using phone subjected rules governing substitute operators nder Rule 5, sections A, B and C above.

9. A State competing for the Trophy ust submit a minimum of six (6) logs om financial members before becoming ligible for contesting the Trophy.

10. Only one contact per station per and is permitted.

11. Serial Numbers: To be exchanged uring the contest will be as follows:—

A. For CW the first three figures will be he RST (Telegraphy) report followed by he serial number of the contact commen- ng with any number between 001 and 00 for the first contact and increasing value by one (1) for each successive ontact. If any contestant reaches 999 he ill then commence at 001 and continue 02, etc.

B. For phone the first two figures will be the RS (Telephony) report, followed by a serial number of three figures similar to the CW contact numbering.

A complete exchange of serial numbers must take place before any points may be claimed for the contact.

12. In order that an equitable distribution of points for States with a large number of contestants compared with a State with fewer contestant may be determined, a sliding scale of points has been allotted as shown in the scoring table appended.

13. In addition to the points in the scoring table that may be scored by a contestant, a bonus of 25 points may be added to the total score for each State worked on 50 MC and above.

14. The log submitted must show in the following order: Date, Time, Band, Emission, Call Sign, RST/No. Sent, RST No. received, points claimed. No log will be accepted unless laid out in this order.

15. A statement signed by the operator must be attached at the conclusion of the log stating that the regulations (Rule 6) and these rules have been observed. Any logs departing from this form will automatically be disqualified.

16. All logs must be forwarded through the contestant's Divisional Council (for membership checking) to reach the Federal Contest Committee, Box 1234K, GPO, Adelaide, on or before 10th September, 1955.

17. Attractive certificates will be awarded to the first, second and third highest in each State. There will be no outright winner for Australia. Where a large number of logs are received from any one State, further certificates may be awarded at the discretion of the Contest Committee.

18. The State to which the Perpetual Trophy will be awarded shall be determined as follows:— To the average of the top six (6) logs shall be added a bonus arrived at by multiplying this average by the ratio of valid logs submitted by that State to the total of amateur licensees in the Division at the time of the contest.

19. The logs which will be accepted for the multiplier under Rule 18 shall show at least five (5) contacts in the contest.

20. The trophy shall be forwarded to the winning State in its container and will be held by that State for a period of twelve (12) months when the winner for the succeeding year is determined.

21. The Federal Contest Committee shall be the sole adjudicators and their ruling will be binding in the case of any dispute.

SCORING

Scoring Table:—

Contacts from VK1 to any State — 6 points. Other States to VK1 — 6 points.

Contacts from VK2 to VK3 — 1 point, to VK4 — 2 points, VK5 — 3 points, VK6 — 5, VK7 — 4, VK9 — 6.

VK3 to VK2 — 1, VK4 — 3, VK5 — 2, VK6 — 5, VK7 — 4, VK9 — 6.

VK4 to VK2 — 1, VK3 — 2, VK5 — 3, VK6 — 6, VK7 — 5, VK9 — 4.

VK5 to VK2 — 2, VK3 — 1, VK4 — 3, VK6 — 5, VK7 — 4, VK9 — 6.

VK6 to VK2 — 1, VK3 — 2, VK4 — 4, VK5 — 3, VK7 — 5, VK9 — 6.

VK7 to VK2 — 2, VK3 — 1, VK4 — 4, VK5 — 3, VK6 — 5, VK9 — 6.

VK9 to VK2 — 1, VK3 — 2, VK4 — 3, VK5 — 4, VK6 — 5, VK7 — 6.

The RD contest provides an opportunity to contact your interstate ex-service friends, at least annually — join in the event and help your division to win the trophy.

AMATEURS AND TV PROBLEMS

THE Postmaster-General, Mr. Anthony, announced early in July the frequency channels for National and Commercial Television to be established in Sydney and Melbourne.

Mr. Anthony stated that the Australian Broadcasting Board had made the following allocations:

Channel No. 2 — 63 to 70 mc/s to National Stations in both Sydney and Melbourne.

Channel No. 7 — 181 to 188 mc/s for two Commercial Stations, one in Sydney and one in Melbourne.

Channel No. 9 — 195 to 202 mc/s for two commercial stations, one in Sydney, one in Melbourne.

The 21 mc gang may make some impact on Channel 2 unless their third harmonics are duly suppressed as undoubtedly they will be.

The following is the complete list of TV channels as listed in Australia.

Channel 1 — 49 to 56 mc/s, 2 — 63 to 70 mc/s, 3 — 85 to 92 mc/s, 4 — 132 to 139 mc/s, 5 — 139 to 146 mc/s, 6 — 174 to 181 mc/s, 7 — 181 to 188 mc/s, 8 — 188 to 195 mc/s, 9 — 195 to 202 mc/s, 10 — 209 to 216 mc/s.

Interference in UK

THE detailed analysis of BCI and TVI complaints investigation of the GPO in the UK during 12 months shows the many problems confronting the authorities and incidentally the listener and viefer.

Of the many cases of TVI investigated, 21,877 cases were listed as the source being unknown, 8956 cases were caused by sewing machines, 7056 cases by commutator type motors, 6954 by hair driers, reducing to 476 cases caused by commercial transmitters, and 303 cases by amateur transmitters.

On the BCI side, 12,206 cases were listed with an unknown source. The next worst offender was 6805 cases caused from the radiation from TV time base circuits of receivers (TVI in reverse), while 142 cases were listed as caused by commercial transmitters and 125 from amateur transmitters.

The RSGB's Bulletin Editorial points out that it would appear if it was the wish of amateurs to give "clean pictures" to their local televiewers they have achieved their object judging from the small number of TVI cases reported.

It is supposed that a considerable number of amateur stations are closed down during TV hours either due to the desire to view the screen, or from fear of TVI. The Editorial also points out that operation is possible on both 1.5 and 145 mc/s with practically no TVI proofing.

On the other bands providing the commonsense TVI proofing advice given in the journal is followed, operation at any time is practicable.

Emergency Service

ALTHOUGH most decisions are only of a preliminary nature, a picture of how amateurs will fit into the State Emergency Service in NSW is gradually becoming clearer.

The NSW State president, Jim Corbin, VK2YC, represented radio amateurs at a high level conference to decide emergency working plans.

The RAAF, Army, Police and WIA delegates discussed communication procedure and made general decisions for any immediate operation.

Decisions made at the June General Meeting of the NSW Division of the WIA were to the effect that Institute funds would be used to purchase VHF Disposal equipment for air to ground working in an emergency. They also endorsed the RAAF proposal that WIA personnel should man equipment set up at airfields at Canberra, Richmond, Williamtown and Amberley during any emergency.

The whole scheme is of necessity at

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stage in a state of flux, but final ns will be announced as soon as prac- ible.

salient point is to the effect that amateur movement is officially recog- ed as a very necessary section of any ergency communications organisation that the WIA Net is an integral part the State Emergency Services of NSW. isitor to Sydney during late June was Federal president of the WIA, Major Mitchell, VK3UM. He afforded NSW isional Councillors and members a t hand opportunity of obtaining the st Federal news and views.

uch personal visits are of inestimable ue in keeping the widespread divisions the Institute closely knit, and in clari- ag points that easily cause misunder- ndings when contact is only avail- e by mail.

DX AWARDS

ATIONAL amateur radio societies in most countries follow closely the RL official countries list in making isions affecting their DX operating ards.

he League's Communications Depart- nt has the responsibility for making isions on the listing of new countries is assisted by other experienced DX ff members.

hree main factors are considered in proaching any new country problems. es the area have political indepen- ice? Does it have adequate geographi- separation from the parent nation? oes it have foreign lands in between?

f any area is declared a new country, amateurs have an opportunity of mak- a contact. The main aim, however, to record an accurate list of countries d keep it under review to ensure it is pt up to date with any government anges. Modifications are only made lowing league inquiry precedents, and nsultation with the US Department of te. Webster's Geographical Diction- y, and Rand McNally.

BLIND AMATEURS

O encourage blind persons to qualify as radio amateurs the Division for e Blind Library of Congress has pro- ced a new talking book, "The Radio nateur's Novice Examination Questions d Answers".

t includes code practice especially itten for the book. The package con- ts of eight 12 inch records and is avail- le to qualified blind readers from the gional libraries in various centres in e US.

WIA NEWS

ELEVISION was the subject of two lectures presented to the NSW Di- sion of the WIA. Max Sobels, VK2OT, ctured to 120 members and visitors at e June General Meeting. Max covered e TV field fully giving many inter- ting insights into transmitting and re- iving techniques.

He covered general information on an- ipated costs in Australia and recorded rvice calls per receiver overseas. The cture was voted one of the finest in cent years.

Norm Beard, VK2ALJ, continued his cture to the NSW VHF section from e June meeting. In July Norm demon- rated a receiver showing various forms TVI and completed a lecture and monstration of topical interest to ama- urs. Over 50 members attended the ction's lecture.

Forthcoming NSW WIA events include e Hunter branches' Field Day to be ld at Blackall's on 2nd October. News the event will be covered over VK2WI d during the branches 14100 kc/s hook- held at 2000 hours each Monday even- g.

The NSW Division's VHF section will nduct their spring 144 mc Field Day er the same weekend, the first in Octo- r. The object will be to relay messages the band to and from other capital ies.

A preliminary meeting was held at bury in July to discuss arrangements r the NSW south-western zones Con- ntion.

The final date has yet to be decided, t will be approximately toward the d of October.

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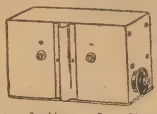

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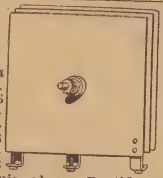

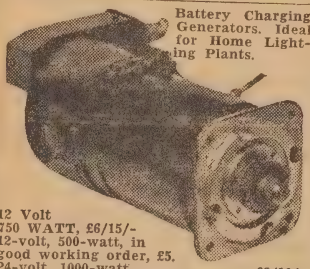

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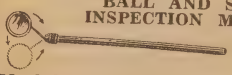

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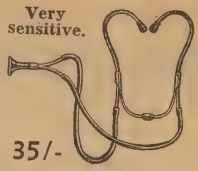

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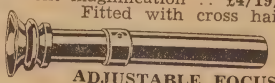

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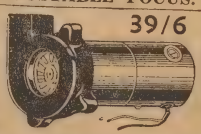

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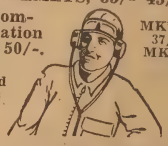

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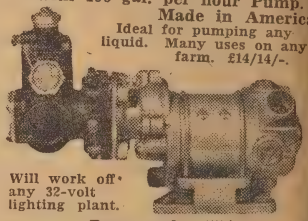
Aircraft 24 volts Motor complet with 400 gal. per hour Pump. Made in America

Ideal for pumping any liquid. Many uses on any farm. £14/14/-.

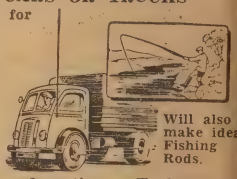


Will work off any 32-volt lighting plant.

Pump only, 55/-.

STEEL ARMY TANK AERIAL RODS WILL MAKE IDEAL RADIO AERIALS FOR CARS OR TRUCKS

Too long for postage. Advise nearest railway station. Bases to suit Aerials, 12/6 each.



Will also make idea Fishing Rods.

12ft long, 3 sections. Each sectio 4ft, 22/6. 8ft long, 2 sections, 15/-.

24-VOLT MOTOR COMPLETE With Fuel Pump

Ideal for Caravans. Takes the place of Hand Pumps.

£5 each

Many uses on the Farm Will Transfe Petrol or Any Liquid from Drums, etc. Will work from 24 or 32 volts AC or DC.

STORES

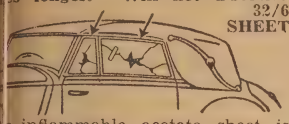
5[illegible] Elizabeth St., Melbourne, C.1.
[illegible]n Victoria Street. Phone FJ5904

and Efficiently Despatched
Include State in Address

IN FIRST-CLASS ORDER DALTON COMPUTERS. IDEAL FOR AERO CLUB. 45/-.

SPECIAL SPECIAL
Stirrup Pumps, all brass, ideal for fruit tree spraying. Worth £4/15/-. **52/6.**

[illegible]lace those broken side curtains [illegible] cellulose acetate which takes [illegible] place of celluloid and lasts four [illegible]s longer. Will not discolor. **32/6 SHEET**



[illegible]n-inflammable acetate sheet is [illegible]ommended for all types of side [illegible]tains. Sheets are 20 thousandths [illegible]1 inch thick. Size of sheet, 24in [illegible]2in. Can be sewn or cemented [illegible]o frames.

BRAND NEW STUDENTS' MICROSCOPES

[illegible]t a toy.
[illegible]real
[illegible]croscope.
[illegible]urs of
[illegible]joyment
[illegible] any boy
[illegible] girl
[illegible]ident.

300 magnifications.

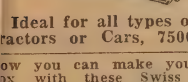
84/-

Test slide included in nice box.

WATCHMAKERS AND INSTRUMENT MAKERS

[illegible]glish Tweezers .. .. .. 6/6 and 5/6
[illegible]eyeglasses .. .. 6/6 and 8/6
[illegible]ctra strong double lens Eyeglasses 15/-
[illegible]rewdrivers, set of five .. 13/9

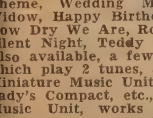
BRAND NEW LEVER TYPE GREASE GUNS WORTH £4/19/6



59/6

Ideal for all types of Trucks, Tractors or Cars, 7500lb pressure

[illegible]ow you can make your own music [illegible]ox with these Swiss music units. [illegible]ey can be fitted to any type of box, [illegible]ll, jug, teddy bears, etc. Hours of [illegible]njoyment for all the family.



30/-

EACH

[illegible]unes available, Lili Marlene, Jingle [illegible]ells, Blue Danube, Harry Lime [illegible]heme, Wedding March, The Merry [illegible]idow, Happy Birthday, Annie Laurie, [illegible]ow Dry We Are, Roll Out The Barrel, [illegible]lent Night, Teddy Bears' Picnic. [illegible]lso available, a few only double units [illegible]hich play 2 tunes, 50 each. [illegible]iniature Music Units fit cigarette case, [illegible]ady's Compact, etc., 39/6, also 230 volt [illegible]usic Unit, works continuously, 59/6

ENGLISH SMITH 8-DAY CLOCKS

As used by the R.A.F.

Luminous Dial.

£5/15/-

Makes ideal car clock.

Fitted with Sweep Second Hand Ideal for any car or truck.

SPECIAL DISPOSALS METER OFFER

0-3 amp meters, AC-DC, 2½in dial .. 45/-
0/1 milliamp, 2½in dial . 37/6
Weston 0-50 volt 0-100 amps. combined M/coil, £3/10/-
English 50-0-50 Ammeters, M/coil 37/6
English 0-50 Ammeters, AC-DC .. 42/-
English 0-40 Voltmeter, M/coil .. 25/-
English 0-300 AC-DC Voltmeters .. 55/-
English 0-5 Milliammeters, 2½in .. 27/6
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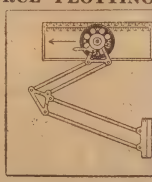
English 0-10 Ammeters, 2½in dial, Moving Coil .. 45/-
English 0-30 Voltmeters, 2½in dial, AC-DC .. 42/-
English 0-40 Ammeters, 2½in dial, AC-DC .. 42/-
English 0-30 Ammeters, 2½in dial, AC-DC .. 45/-
English 0-150 Voltmeter, 3in dial, Moving Coil .. 39/6
Eng. 0-500 Micro Ammeter, M/Coil 37/6
Eng. 0-20 amps, 2in dial, M/c. 25/-
Eng. 0-1½ Milliamps, 2in dial, M/c. 19/6
Eng. 0-200 Ammeter, M/Coil .. £4/10/-
Eng. 20-0-20 Ammeter, M/Coil .. 37/6
Eng. 0-30 Amps AC-DC 2½in dial 42/-
Eng. 0-50 Amps AC-DC 3½in dial, 75/-
Eng. 0.80 Amps AC-DC 3½in dial 75/-
Eng. 0-1 Amps DC 2½in dial .. 35/-
Eng. 0-5 AC-DC 2½in dial .. 45/-
Eng. 200 Amps AC-DC 3½in .. £4/19/6

AMERICAN VACUUM or AIR PUMP

Builds up air pressure to 20lb at 1000 R.P.M. develops up to 120lb of hydraulic pressure; will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems, **£3/10/-.**

AIR FORCE PLOTTING BOARD

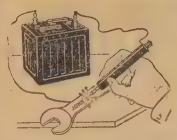
Ideal for use as Students' drawing board.



25/- Complete

Complete with Drawing Arm.

AT LAST THE ELECTRIC ENGRAVER THAT WORKS OFF ANY 6 OR 12 VOLT CAR BATTERY



29/6

Complete with Instructions.

Engrave your own tools, name plates, dog collars, cutlery, watch cases, cigarette cases, etc. Engraved articles are never stolen. Can also be worked off 230 volts. Transformers to suit **50/-**

SPECIAL OFFERS FROM OUR NEW MOTOR ACCESSORY DEPARTMENT

American Shrader tyre pumps, work from your spark plugs, **39/6.** Car type fire extinguisher. Every car should carry one. Cost £7/10/-, **£4/10/-.** Steel mechanics' tool boxes, **19/6.** Brand new 7/8in spark plugs, suit most old type cars, **2/6,** or ideal for tractors. S.A.E. or Whit. Spanner Sets, open one end, ringed the other, 6 spanners to set, **23/6.** Army steel tow ropes, looped ends, **17/6.** S.A.E. open end spanners, 6 to set, **24/6.** Whitworth, 4 to set, **18/6.** Whit socket sets, **13/6** set. Mudguard type rear view mirrors, **16/6.** Inside car rear view mirrors, **4/11.** S.A.E. socket sets, **15/-.** Stick on type ash trays, **4/-.** Engineer's pliers, **4/6.** Car jacks, **37/6.** Tyre levers, **3/10** each. Hydraulic 2-ton jacks, **£4/15/-.** 6-volt windscreen wipers, **£4/12/6.** 12-volt **£4/19/6.** Car pumps, **14/-.** Shifting Spanners 4in **6/9;** 6in **8/-;** 8in **10/-;** 10in, **11/-;** 12in, **18/6,** Metri-Socket Set, complete with bar, **59/6.** Feeler Gauges, **4/6.** Tail Lights, **5/9:** 12in Steel Rulers, **3/6.** 6in, **2/6.** Set of 3 Screwdrivers, **2/6.** Hydrometers, **11/6.** Piston Ring Compressors, **15/-.** Pressure Oil Cans, **19/6.** Combination Pliers, **5/6.** Multi Grips, **10/6.** Car Amp Meters, **15/6.** 4½in saw blades complete with arbor, ideal for making saw bench with electric drill, **25/-.** Bell-ringing generators, ideal for telephones, **25/-.** German Army marching compasses, work similar to prismatic, **32/6.** 110 volt 1000 watt projector globes, **32/6.** ¼in Black and Decker 230 volt electric drills, **£11/15/-.** ½in, **£24/8/3.** Magnifying Glasses, 8 mags., **8/6.** 10 magnifications, **12/6.** 24 volt motor and hydraulic pump, capacity 3½ gals. per minute, **£3/15/-.** New headphones suitable for crystal sets, **17/6 pair.** Army Mosquito Nets, ideal camping, **27/6.** Genuine RAAF Berets, **10/6.** Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, **39/6.** 230 volts input. Brand new American Cutting and Welding Torches **£4/4/-** complete. Army Slouch Hats in good order, **15/-.** Generator Test Meters, 35-0-35 amp meters, 4½in dial, **45/-.** 0-10 volt meters, 4½in dial, **45/-.** Loading Resistors can be supplied to make meter read 10.20 at **12/6.** Medical Scalpels, many uses, photographers, etc., **6/6.** Motorist Clip-on Trouble Lights with magnified bull's-eye lens, 6 volt, **7/6;** 12 volt, **6/6.**

MAN-MADE PRECIOUS STONES

(Continued from Page 19)

into alumina at high temperature. It must be of an extreme purity even a purity of 99.99 pc being not enough for some purposes.

If any trace of another element is present the resulting gem will show lack of clarity.

To fuse the extremely fine powdered alumina a special type of furnace is employed. This is a modification of that devised by the aforesaid Professor Verneuil.

Small quantities of the alumina is held in a container above a vertical tube through which oxygen flows. This is surrounded by an outer tube containing hydrogen.

HIGH TEMPERATURE

The powdered alumina falls in a fine stream through the oxygen tube where it emerges in the flame produced by the union of oxygen and hydrogen. The temperature at the tip of the burner is 4500 degrees Fahrenheit.

This intense heat fuses the alumina and the molten globule falls on to a ceramic plate where the drops continually build up into an elongated mass shaped somewhat like a bullet. This mass crystallises as it cools.

The mass is called a "boule" and ranges in size from 20 to 1000 carats. The size depends on the color of the material being made.

Deeper colors require smaller boules while white sapphire boules are made up to 1000 carats in weight. It takes about four hours to make a boule of 300 carats.

All the colorless boules are called white sapphire. This is used for jewellery and bearings and the needles of modern gramophone pickups.

When rubies are required the same material is used with the addition of up to 2½ pc chromium oxide.

The color depends on the amount of chromium oxide present. Small amounts give varying shades from pink to red.

The addition of something under 1 pc of titanium and iron will produce a blue sapphire.

When the boule is cool the tip is broken off and the boule automatically splits in two pieces with a clean surface. These two pieces can then be treated the same as any stone by sawing and cutting and grinding into all the shapes required.

Corundum is also produced in the form of thin rods. These can be bent, polished and shaped into many forms by heating in an oxy flame at a temperature of 3100 degees. By merely rotating the rod in this it can be polished so perfectly that no scratches can be seen under a high powered microscope.

The beautiful synthetic star stones now on the market are made from synthetic rubies or sapphires into which needles of synthetic ru have been included in the form a star. The result is a gem of gr beauty.

Can you imagine anything better a diamond in fire and spark? Yet a synthetic material is n made which actually does that. is known as "titania" or synthe rutile.

While it is superior to a diamo in fire and sparkle it is much soft being about the hardness of quar Nevertheless it is far above t ordinary glass brilliant and mak a magnificent gem.

Synthetic rutile is made fr chemically pure titanium oxi powder which is fused in a simil fashion to the alumina in the coru dum process.

The boules of titanium oxide a black and brittle but further he treatment makes them transpare and strengthens them. Colors a obtained by the addition of certa impurities.

Synthetic emeralds are very di ficult to make. It appears that the is yet only one commercial mak in the world and the process known to be costly but that is that seems to be known about it.

So far we have mentioned noth ing about synthetic diamonds, t reason being that for all practic purposes there aren't any.

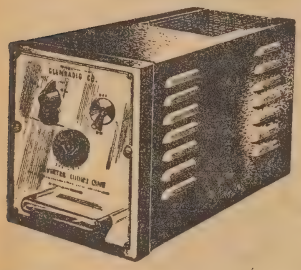
Attempts have been made f many years to grow artificial di monds. All kinds of devices we employed. Balls of iron with ca bon enclosed in a cavity with were heated to redness and plunge into cold water. It was thought th the resulting pressure and sudde contraction would produce a di mond. It didn't.

Graphite has been exploded i guns with cordite explosive with n results.

It seems that great pressure an heat is required and that the mean are yet beyond man's endeavors un less the atom-bomb exploded in th earth will do it. But there may b no one left by that time to use th diamonds, if any, thus produced.

INVERTERS for every PURPOSE

240 VOLT AC 50 CYCLE INVERTERS



Excellent frequency stability. Radio interference suppressed.

Surge suppressors fitted to every unit! Available for use with radio amplifiers, tape recorders, synchronous motors, radiograms, etc..

Packed weight approx. 30lb.

Size 11in x 6in x 7¼in

Special models with different voltage input and output load manufactured on application.

Please add freight on all orders

TRADE ENQUIRIES INVITED

NOTE PRICE LIST

INPUT VOLTS D.C.	OUTPUT W AT 240V	PRICE RETAIL
12	100 watts 50cycle	£30/12/-
32		
240		

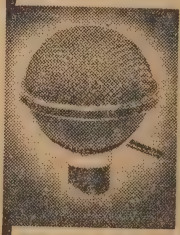
Prices of higher wattage inverters on application

GLENRADIO COMPANY

4 Renwick Street, Leichhardt, Sydney. LM4545

AWA RONETTE

MICROPHONES & ACCESSORIES



Type 088/F

£8/12/-

Technical pamphlets will be mailed on request. Other types also available from

NEWTON McLAREN

17 LEIGH ST., ADELAIDE

and leading wholesalers.

HERE'S YOUR ANSWER, TOM!

(Continued from Page 63)

will buy in the end, will depend hat you intend using it for. And how much you are prepared to for it. As with many other gs, the good ones are not cheap. aving disposed of pickups and e problems, we turn our atten- to another question of Tom's, erning the overhead wires ying electric power into homes. it is.

How is the current carried in- homes? Most houses seem to ve two wires from the light le. What are they for? Does e carry the current? Is the her an earth wire?

here seems too much confused king on Tom's part as regards electricity supplies. If the second is only an earth wire, why ld we bother to put it up? It ld be so much simpler to earth thing that has to be earthed, to earth electrode in the back yard! it would be less wasteful of e.

earthing were not required, we ld even scrap the earth electrode just get our power from the one e. We are sure, councils and elec- ity supply authorities would wel- e this new system!

ON'T WORK

he only trouble is that electricity, ng what it is, could not be put to k that way. No, Tom, both those es are necessary, and the fact t one of them is earthed is merely ncidental.

ou see, electric current is actually ow of electrons along a conductor. be able to flow, they have to come m somewhere and go somewhere. d if they don't want to get lost, y have to get back whence they ne.

he electrons are set in motion in generator at the powerhouse. ey flow along one wire, to the se, then through the appliances the house. Having done their rk of heating, lighting, &c., they urn to the other end of the gen- tor through the second wire. ich in the same way as cars in a e-way street, electrons could not ne and return through the same re. They go around in circles, or ter, circuits.

For every electrical circuit you ve a forward and a return path, d the two wires going to a house ovide just that.

VITCHES

f you want to stop the current wing, Tom, you just break one of e wires. Of course, these days we n't worry about cutting and twist- together wire ends, to put the hts on, because we have switches ich make or break the circuit. What we have said applies to both ect current and alternating cur- nt. The only difference is, that th direct current the flow of elec- ns goes in one direction only. With ernating current the electrons all ve in the one direction, then make bout turn" and move back the me distance. But at any instant, ey move in all together in either direction, so they still need the two paths.

So you see, Tom, the one-wire idea would be very nice, if it worked. It doesn't, worse luck.

When using an electric gramophone with a 32v vibrator receiver, the volume drops noticeably when the motor is switched on. There is a condenser on the motor. Has that got anything to do with it, or is something else causing the effect?

We have a strange suspicion, Tom, that the condenser has very little to do with the drop of volume. The wires leading from the battery to the set are more likely to cause some bother. This is where Ohm's Law comes into the picture.

This law states, that if the current I flows through a resistance R, the voltage applied to the resistor is E. This is what it looks like in the formula:

(1) IR equals E.

This is an equation, and we can transpose its members like so:

(2) I equals E/R.
(3) R equals E/I.

We know the voltage and we can measure the current drawn by the receiver and the motor. Supposing the receiver current works out at 1 ampere and the motor current at 2 amperes. To do this we will need to connect them to the battery with as short and thick leads as possible, which have negligible reistance.

According to formula (3) this will give a resistance of 32 ohms for the set, and 16 ohms for the motor. The two connected in parallel will give an aggregate resistance of 10.7 ohms.

LEAD RESISTANCE

However, in practice, the leads will be quite long, and if they are not too thick, they will have appreciable resistance. We could assume about 2 ohms.

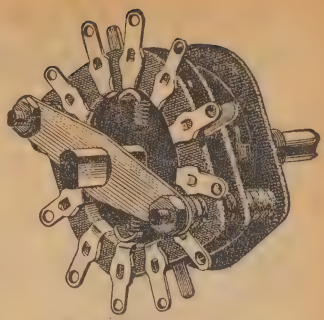
This resistance is effectively in series with the appliances. Whilst the receiver only is switched on, its effect may be negligible, giving only 32 plus 2, 34 ohms. What happens, though, when we switch the motor on? The 2 ohms will be in series with only 10.7 ohms!

Working it out from formula (2) we find that the current is now only 2.5 amp., as against the 3 amps. that it should be.

According to formula (1) we can work out that it requires 5 volts to drive 2.5 amps through a resistance of 2 ohms. This means that we are losing 5 volts along the leads, which leaves only 27 volts to drive both set and motor. Such a reduction in voltage will seriously reduce the HT voltage from the vibrator, with the consequent reduction of output from the receiver.

The remedy? Use as thick and as short wires as possible to reduce this unwanted lead resistance.

The condenser is simply a safeguard against interference from sparking motor brushes. DC will not pass a condenser, so consequently it cannot draw current and does not enter into the calculation at all.



ROTARY
PALEC SWITCH
10 AMP.

(World Patents pending)
GENERAL: It is the only Single or Multi-Pole Rotary Selector Switch which combines 10 Amp. current capacity with small physical dimensions. It is interchangeable and can be used in conjunction with an "Oak" type assembly.
Mechanical Operation Test. The Palec Switch has withstood 50,000 revolutions at 60 R.P.M. without mechanical failure.
RATING—10 Amp., 250 V.A.C.
CONTACTS—
Silver Plated—non-shorting only.
Resistance—800 Micro-Ohms.
TEMP. RISE ON CONTACTS—
(with 10 Amp. Conductors)
at 10 Amperes 10° C. rise
at 20 " 30° C. rise
at 30 " 50° C. rise
DECKS—1 to 8 max.
POLES PER DECK—
1 Pole—max. 12 contacts
2 Pole—max. 6 "
3 Pole—max. 4 "
4 Pole—max. 3 "
OVERALL DIAM., 2-1/16 in.
TECHNICAL SERVICES—
We will design and build Switches to requirements.
Available—leading Wholesalers.
Quantity prices on application to:

PATON ELECTRICAL PTY. LTD.
90 VICTORIA ST., ASHFIELD, SYDNEY

AWA
RONETTE
MICROPHONES & ACCESSORIES

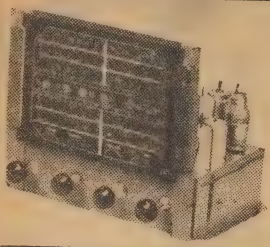
Type TO-284
£2'12'-

Turnover pickup cartridges for standard and long play. Available in alternative response characteristics as models OV, P, T, TS.

NICHOLSONS LTD.
BARRACK ST., PERTH
and leading wholesalers.

NEW RADIOGRAM - CHASSIS KIT - SETS

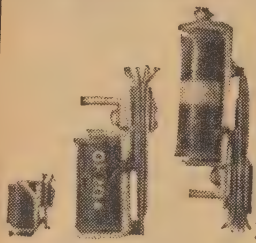
5 VALVE DUAL-WAVE



Complete kit of parts including 12in Magnavox or Jensen Speaker, five valve (1 6J8, 1 6K7, 1 6SQ7, 1 6V6 and 1 6X5) and all other parts to the last nu and bolt to complete the five valve dual wave chassis illustrated.

These chassis when completed give excellent overseas, local and interstat reception as the coils supplied and intermediate transformers are high gai Permatune iron cored. Pick-up switch and volume control with A.C. switch supplied. Suitable for use with any crystal or high impedence magnetic pick-up

LIST PRICE OF PARTS £25 **SPECIAL PRICE £14/17/6** F.O.R.



AMERICAN RELAYS

No. 1 Miniature relay 300 ohm coil, S.P.D.T. contacts, 10/-
No. 2 Standard relay 250 x 250 ohm coil 4 pole S.T. 7/6
2 pole S.T. 6/6
No. 3 Standard relay, 15,000 ohm coil, 2 pole S.T. .. 12/6
All relays suitable for rewinding.

New dynamic mike inserts	8/6
Bakelight fuse boxes	4/6
Carbon mike transformers	3/9
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Shielded hook-up wire, per yd.	8
Morse keys	4/6
12v 400 watt prefocus globes	7/6
3 gang standard condenser	18/6
3 gang midget condenser	18/6
2 gang standard condenser	15/-
2 gang midget condenser	15/-
26-pin plug and socket	5/-
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Fuse holders, bakelite, single hole mounting	2/6
Lifeboat transmitters	22/6
Teletron octal sockets, doz.	3/6
9-pin loctal sockets, doz.	5/-
6-pin wafer sockets, doz.	3/-
5-pin ceramic sockets, ea.	2/-
Acorn sockets, ceramic, ea.	3/6

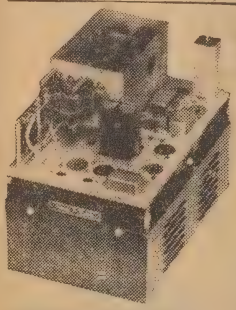
RELAY-TYPE COUNTERS

("Mercury" American Made) These relay counters registe from 0 to 99,999. Can be supplied with 250ohm, 500ohm or 5,000ohm coils.

29/6
plus postage

New A.C. 240V. power supply for above complete with valve.

57/6 PLUS POST



12/6
PLUS FREIGHT
BY PASSENGER TRAIN ONLY
Not recommended for interstate customers.

I.F.F. CHASSIS

CONTAINED IN ALUMINIUM CASE

H.F. Oscillator, frequency approx. 200 m/c, complete with 10 high insulation octal sockets, two 7193 valves, I.F. transformer, 45 insulated carbon resistors, mainly 2 watt, 24 paper and mica condensers.

50-CYCLE A.C. AMMETERS

Range 0-5 Amps.
Scale Size 9in Dia.

Price, each.

37/6

Packing and postage: NSW, 7/6; Interstate, 12/6.

NEW COILS AND INTERMEDIATE TRANS, STANDARD OR MINIATURE
By A LEADING MANUFACTURER

Permatune I.F. trans. 455K.C.	9/6
Aer. Permatune B.C. coils 455K.C.	7/6
R.F. Permatune B.C. coils 455K.C.	7/6
Osc. Permatune B.C. coils 455K.C.	7/6
Aer Permatune S.W. coils 16-50M.	6/6
R.F. Permatune S.W. coils 16-50M.	6/6
Osc. Permatune S.W. coils 16-50M.	6/6

PEDAL-GENERATING SETS

These units in new condition will generate 12 volt at 5 amp. or 6 volt at 8 amp. Could be motorised if required. Complete with generator, reduction gear, stand, meter (3in) etc.

£8/17/6 F.O.R.

NYLEX HOOK-UP WIRE AT HALF PRICE

Nylex hook-up wire 10/.010 in 100 yard coils, each coil consisting of five 20 yard lengths in 5 different colours. **10/- PER 100 YDS.** Plus postage.

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PHONE LA6087

479 PARRAMATTA ROAD,
LEICHHARDT, NSW. PHONE LM3610

NEW AMERICAN TELEPHONE WIRE CLEARANCE

Rubber-insulated with stainless steel and copper conductors supplied on metal reels each containing half a mile of wire.

½-mile reels were 37/6 NOW 20/- Post Extra

In case lots—6 reels (3 miles) were £10/-/- NOW £5/5/- F.O.R.

NEW 5 VALVE D.W. BATTERY CHASSIS

This D.W. battery mantel chassis which is made by leading manufacturer is fitted with heavy duty Rola 6in speaker, tone control, etc., and gives excellent reception on local, interstate and overseas stations. Ideal for building into existing furniture, boats, caravans, etc. Valves used—two 1T4, one 1R5, one 1S5, one 3V4.

£5/17/-

NEW VALVES CAN BE SUPPLIED AT £3/10/- EXTRA

Postage and packing on chassis extra. NSW **17/6**, interstate **25/-**.

MIDGET GENEMOTOR

Input 28 to 32v at 1.1 amp. Output. 250v. at 60MA. New in carton.

£2/5/-

Used but in good order.

£1/10/-

Postage extra.

Input filter supplied with genemotors

28 volt GENEMOTOR

Input 28 to 32v. Output 250v at 65mA. Used but AS NEW.

£1/5/-

POSTAGE EXTRA

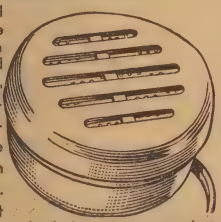
NSW 5/-, Insterstate 11/-.

—WANTED—

TEST EQUIPMENT, COMMUNICATIONS RECEIVERS, SURPLUS STOCK, ETC. HIGHEST PRICES GIVEN.

PILLO-FONE EXTENSION UNIT

It's a real miniature with Rola unit. Install it anywhere, in the sick-room, work-shop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾in deep.



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New Creed relays complete with original cartons.

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Special price for quantities.

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These new all-brass 108 aerials measure 13 inches and extend to 4ft 3 inches in five sections. .. **17/6**

Bakelite mounting base for abvoe. **4/6**

Plus Postage

24-VOLT MIDGET MOTORS SHUNT WOUND

Fully Laminated Fields Wound Armature. May be operated from AC at a slightly higher voltage. Sixteen Segment Commutator, ball-bearing Armature. Ideal for Model Trains, Hobbyists, etc. Condition New.

Price, each **39/6**

Packing and postage: NSW 1/6; Interstate 2/6.

FOR CONSISTENT LOW PRICES ON ALL DISPOSAL AND SURPLUS EQUIPMENT

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NEW 5in AND 6in PERMAG SPEAKERS BY LEADING MANUFACTURER

(5C) 5in STANDARD 24/6
(5F) 5in HEAVY-DUTY 29/6
(6H) 6in HEAVY-DUTY 29/6

Available with 10T or 7T Transformer

POSTAGE & PACKING EXTRA
N.S.W. 4/6—INTERSTATE 5/6

NEW "VELVET-ACTION" RECORD CHANGERS BY STROMBERG-CARLSON

Latest Model at almost ½ price

Model 104—Three speed automatic pla all microgroove and standard records In original cartons £14/17/6 F.O.R.

ALL GOODS ADVERTISED ON THIS PAGE ARE NEW

NEW VIBRATOR POWER-SUPPLY

Input 6V. output 230V. at 50 MA. These units made by A.W.A. are free from hum or hash. Supplied complete with standard synchronous vibrator. **£3/15/0** F.O.R.

ELECTROLYTIC CONDENSERS

12mfd 525 V ... 3/9
500mfd 12 V ... 2/-
4mfd 600 V ... 1/9
8mfd 350 V ... 2/-
10mfd 40 V ... 1/6

(Plus Postage)

12-inch P.M. SPEAKERS

Heavy duty 12in per-mag speaker by well-known manufacturer. 10T. C.T. or 5,000 Transformer. **NOW 47/6**
POSTAGE NSW 5/6, Interstate 7/6.

MUIRHEAD VERNIER DIALS

These New Vernier Dials are ideal for test equipment, receivers, etc
(as used on AR8 sets)
27/6 ea

NEW VIBRATORS

A.W.A. standard six pin synchronous vibrators in original cartons 12 volts. Half price.
17/6
Plus postage.

RECEIVING VALVES

1T4	11/6	VR105	15/0
1S5	15/0	957	7/6
3V4	15/0	VR150	15/0
1R5	15/0	2050	15/0
6SA7	10/6	955	7/6
6SQ7	10/6	9001	7/6
6SN7	10/6	9004	7/6
6SL7	10/6	717A	7/6
6AG7	10/6	7C5	7/6
6AC7	10/6	EF50	10/6
6AG5	12/6	12SR7	2/6
6J7G	10/6	1K5	2/6
6K7G	7/6	VR65A	2/6
6J6	15/0	12SQ7	2/6
EL33	12/6	6SH7	7/6
EBF35	12/6		

ALL PLUS POSTAGE

CARBON RESISTORS

Colour-Code
Card-Supplied

Well-known make of carbon resistors in values of 100 ohms to 5 megohm. In 1-watt, ½-watt and 1/3-watt. All resistors are standard color coded and in original cartons. In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt 25 1/3-watt.
Price ... **8/6**
Post 1/6.

Power Transformers

New midget power trans. Upright mounting with cover plates. 240v. Pri. Sec. 225 x 225 at 50 Mill. and 6.3V. at 3 AMP.

17/6
Plus postage 2/6 NSW 3/9 interstate

Transmitting Valves

866	15/0	803	£2/0/0
832	£2/0/0	1616	£1/10/0
100TH	£2/0/0	828	£2/10/0
		837	£1/10/0

I.R.C. RESISTORS

I.R.C. carbon resistors, ½, 1 & 2 wa in values 50 ohm to 5 meg. includi many popular sizes, 3T, 15T, 20T, 2 50T, 100T, 250T, 500T, etc.
(Standard resistor color code supplied

20/-
(Plus 1/6 Postage.)

NEW VIBRATORS

6 volt A.W.A. gas-filled vib rators. Heavy duty synchronou **NOW 7/6 or 70/- per doz**

NEW 1T4 BATTERY VALVE
11/6 ea

PICK-UP CARTRIDGES

Rothermel high fidelity pick-u cartridge. Replacement fo most pick-ups. **7/6 ea.**
ACOS Cartridges 10/-

SAPPHIRE NEEDLES

Rothermel sapphire needles play 2,000 recordings. Mad in England. **3/9 or 30/- doz**

DYNAMIC SPEAKERS

7in Dynamic speakers by leading manufacturer,
1,500 ohm Field coil,
7,000 ohm Transformer
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Ovaltone Dynamic Speaker
9in x 6in. 1,000 ohm Field, 5,000 or 7,000 ohm Transformer
NOW 20/- EACH
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NEW H.F. TRANSCEIVERS

34-APS 13C (Tail-end-Charlie) Freq. 420 mcs. con- in 16 valves 9-6AG5, 5-6J6, VR150 and 2.2D2. Also midget 24v Genemotor.

ss valves—£5/-/-

£10

FULLAPHONES

ontaining pair headphones, morse-key buzzer, key itches, etc., in case. **20/-**

Post NSW 7/- F.O.R. Interstate 11/-.

NEW H.F. RECEIVER—R3118

(RESPONSE UNIT)

he ideal receiver for the 144 M.C. Band uses 3 6.3v valves, including two tuned R.F. stages. upplied complete with valves, plugs and A.C. power supply. (240v.)

£9/17/6 F.O.R.

NGLISH I.F.F. MOTOR

glish I.F.F. motor complete with arbox. 18v D.C. operation but suit- e for conversion to A.C.

ere £2/10/-, Now 37/6

stage extra — N.S.W. 5/- Inter., 8/6

75 ohm CO-AXIAL CABLE

75 ohm Coaxial Cable 1/9 per yd. Minimum quantity 10 yards on drums each containing 110 yards. £7/10/- F.O.R. Co-Ax. Plugs & Sockets (Pye Type) 3/- Pr. American type 4/- pr.

NEW MORGANITE SWITCH POTS

These new Potentiometers .5 meg. with double pole switch. **6/6** Postage extra

A.T.5 TRANSMITTER

A.T.5. Transmitter covering 140 K.C. to 20 M.C. in two separate tuned circuits. Provision for crystals. Complete with valves. Three 807 and two 6V6.

£4/17/6 F.O.R.

A.T.5 POWER SUPPLY

24 volt genemotor supply containing two genemotors, one giving 550 volt at 350 mills. and the other 250 volts at 100 mills. Also contains filter condensers, relays, fuse holders, etc.

£2/10/- F.O.R.

£8/15/- F.O.R.

NEW AMERICAN INDICATOR-UNIT

These indicator units contain the following valves:

Six 6SN7GT, one 6G6, one 6H6, one 6X5GT, one 2X2, and 3BP1 C.R.O. tube which is fitted in a separate shield on a 4ft shielded lead and supplied with control box and plug; case and shield are finished in black brocade. In original cartons.

TRANSFORMER TO CONVERT THIS UNIT FOR 240 VOLT OPERATION AVAILABLE AT £3/15/- EXTRA plus postage.

A.M.R. 300

COMMUNICATION RECEIVER

This first class 10-valve receiver made by S.T.C. has a band spread coverage of 1.5 to 24 mcs in switched bands—240v AC operation—supplied complete with valves, crystal, S meter & speaker, air tested. **£47/10/-** F.O.R.

New 12 volt vibrator supply for above complete with leads, spare valve and vibrator 3-6 x 5 & 2 vibrators. **£5/15/-** F.O.R.

OIL FILLED CONDENSERS

(Working voltages stated)

20mfd. tapped	600v.	17/6
2mfd.	1,750v.	12/6
3mfd.	2,000v.	17/6
4mfd.	500v.	6/6
4mfd.	200v.	4/6
8mfd.	400v.	8/6
.5mfd.	200v.	2/9
.25mfd.	750v.	2/9
.01mfd.	3,000v.	5/-

(all above plus postage)

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PHONE LA6087

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PHONE LM3610

MOTOR SPARES LTD

CATHODE RAY TUBES

Bargains in new Cathode Ray Tubes.
5BP1 5 inch tubes 39/6
VCR97 6 inch tubes 39/6
ACR10 2¾in tube (few only) 39/6
VCR522 1¾in tube 35/-
The ACR10 & VCR522 are ideal for constructing small oscilloscopes, etc. In formation on socket connections and characteristics is available on request.

Bargains in RADIO VALVES

954 Pentode Detective amplifier, acorn type 6.3 volt filament for high frequency work.

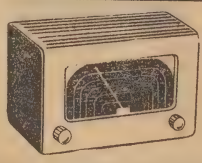
Price only 5/6ea.

VR130—2 volt triode for battery sets, fits octal socket. Each 2/6
NR74—High powered output tetrode similar to 807, but with 4 volt filament and special English Base. Each valve supplied with socket at only 7/6 ea.
1H4G—Valves 2 volt battery triodes Each 3/6
KY21—Eimac Rectifiers, ea. .. £2/10/-
RX21—Eimac Rectifiers, ea. .. £2/10/-
866A—Rectifiers, few only, ea. .. 27/6
AV11—Rectifiers, ea. 10/6
2X2 Rectifiers, ea. 14/3
PEN A4 High slope output Pentode Eng. 7 pin base, 4 volt filament, only, each 5/-
EF50 Valves, only, ea. 10/6

CHIEFTAIN MULTIMETER

New Model using 100 ohms internal resistance meter, sensitivity 1000 ohms per volt. Voltage readings 0-15, 0-150, 0-300, 0-600. Ohms 0-100,000. This is pocket size meter, ideal for the Electrician serviceman, amateur, motor mechanic and handyman.

Price only £4/12/6



ONE VALVE KIT SET FOR THE LEARNER

Although this little set is quickly and simply built, it looks like a factory built job. The wooden cabinet is covered with burgundy leatherette, and the dial has all Australian stations marked in different colors. Parts are mounted on a wooden base-board and anyone can build it if they can use a soldering iron. Circuit diagrams, wire, solder, etc., supplied. Price for complete kit of parts, including Valve, Headphones and Batteries, at normal price is £8/5/-.

Our price is £5/19/6
Weight 9lb 2oz.

HEAD PHONES

We have stocks of the following Headphones, both are brand new and boxed and in perfect condition.
German High Impedance Phones (illustrated) Impedance 4000 ohms; adjustable for maximum output and clarity; light weight, each fitted with cord and plug. A very fine phone ideal for crystal sets and for any other purpose. Weight 1¼lb. Worth £4/10/-.

Our price 39/6

English Low Impedance Phones — Robustly constucted and efficient in operation, fitted with cord and plug. Our price 18/6.

SPECIALS

1. **Morse Code Sets,** each unit built on baseboard and has key, buzzer battery and connections for headphones and line. Ideal to learn the Morse code. Brand new. Made in England. **Only 18/6.**
2. **Germanium Diodes.** Ideal for Crystal sets, also for rectifiers in meters and radio set detectors. **Only 4/11.**
3. **Phone Jacks.** Closed circuit type, brand new and perfect. **Only 2/6.**
4. **Micro Switches,** multi-contact type, suitable for all voltages up to 240 **Only 3/9 each.**
5. **Dynamic** headphones. Single earpieces only, less headband, these will make an excellent pillophone, or small speaker. Sacrified for only **2/9 each.**
6. **Transformers** to suit above earpiece, **4/6 ea.**
7. **Carbon Microphones.** Hand type with switch in bakelite case. **Price 5/6 ea.**
8. **Transformers** to suit above microphones. **Price 4/6 ea.**
9. **Amphenol Ceramic** Octal Sockets. Excellent for high frequency and high voltage work. Worth 5/- ea. **Our price 2/6.**
10. **4 pin Ceramic Sockets. Our price 2/- ea.**
11. **No. 22 Transceivers** in good condition with valves (no power supplies). **Price only £8/19/6.**
12. Black Pointer Knobs suit ¼-inch shaft with grub screws. **Only 6d ea.**
13. **Meter Rectifiers** 1 to 5 ma. Brand new, made in USA. **19/6 ea.**
14. **Record Changers.** Reconditioned Single Speed record changers guaranteed in working order. Well known makes: Garrard, Collaro, HMV, Stromberg Carlson, Plessey. **Price reduced to £4/10/-.**
15. Electric Clocks for building Clock Radio. Genuine Smith's Clocks with switch contacts, alarm, slumber, automatic and manual controls. **Price only £5/19/6.**

SPECIAL NOTICE

All parcels sent registered post unless otherwise stated. Postage or freight must be included with order.

SPECIALS

16. **Electric Shaver Packs.** These connect to a 6 volt battery and DC supply suitable for operating any AC, DC, Electric Shaver, shave, Shavemaster, Remington, Brand new. Worth £8/15/-. **Price £4/13/-.**
17. PE.94A Genemotors. Input 28 v Output 300 volts DC at 260ma volts DC at 10ma, 16 volts DC 5 amps. Enclosed in metal box cooling fan, could be converte 32 volt motor. **Price 25/- ea.**
18. 3-speed Gramophone Motors to o ate off 230 volt AC. These fitted with speed control knob are suitable for playing both s dard and microgroove record **Our price £5/10/-.**
19. High Fidelity turnover head cr pickups to play microgroove standard recordings with 2 bui sapphire needles. Suitable for a motor. **Price only £3/15/-.**
20. 3-speed Gramo Motors with fidelity turnover crystal pick-u operate off 240 volts AC. T have automatic stop and are a known make. **Price only £8/19/**
21. Spring Gramophone Motors, v up type ideal for replacements portable gramophones, etc. C plete with turntable and fitti **Price £3/10/- ea.** Special price quantities on application.
22. **Transistors** made by Philips. Ty OC70 & OC71, **now 37/10 ea.**
23. **Rheostats,** 250 ohm 25 watt. Wo on Mica with porcelain insulat **Price 4/6 ea.**
24. **Potentiometers,** 100 ohm W wound. Well known make, br new. Worth 9/6. **Our price**
25. **Resin Cored Solder,** 1lb reels. Wo 17/-, **our price 9/6.** 2oz reels 1/3
26. **Ceramic Spacers,** ¼in long, ¼in meter with 1/8in tapped hole. **ea. 1/6 doz.**
27. Heavy duty double ignition tog switches. Ideal for boats, cars trucks. **1/6 ea.**
28. Oil filled bath-tub condensers. M in USA.
.1 600V 2/- ea.; .5 600 V 3/- ea; 1 100V 2/- ea.; 2mfd 600V 5/- ea.; plus .05 600V 2/- ea.; .1 plus .1 6 3/- ea.
29. **Army Morse Key,** new, cad-pla on bakelite base. Sacrified for o **2/9 ea.**
30. Condenser banks containing 4 mfd 12 volt condensers, connect in parallel giving 2000 mfd volt in all. **2/- ea.**
31. Indicator Lamps, made of bla bakelite with red or clear gla ideal for instruments, tail ligh side lights, etc., on motor vehicl Screw in torch globes fit into the lamps. **Price only 1/6 ea.**
32. Ferroxcube rod aerials with c ideal for portables, etc. Equal 60ft outdoor aerial. **Price only 1 ea.**
33. EA50 Sockets 3 pin. **2/- ea.**
34. Metal Cabinets finished in mottl cream, size 14 x 7 x 6½. Suit MK dial and 5 or 6-inch speaker. Wor 30/-, **our price 10/- ea.**
35. IFF sets type No. R 3121. In ne condition with 13 valves, 18 volt 450 volt at 50 ma genemotor a blower, carbon pile regulator, multicontact relays and dozens resistors and condensers of all type **Price only £4/10/-.**

547 ELIZABETH ST., MELBOURNE ALSO AT — ALBURY ARARAT BAIRNSDALE BALLARAT
BENALLA BENDIGO BROKEN HILL COLAC DANDENONG ECHUCA SALE FRANKSTON
GEELONG MILDURA SHEPPARTON ST. ARNAUD WAGGA WANGARATTA WARRAGUL

ANSWERS TO CORRESPONDENTS

H. (Poona, India) forwards a sub- on for Radio Television and es and wants to know if he can back copies of Radio and Hobbies whether we have ever published ooks covering a series of articles the magazine. He also expresses ppreciation of the magazine, par- ly the Serviceman articles.

Many thanks for your letter, D.S.H., ou should have received an official t for your subscription by this We can usually supply a few odd of back numbers but it is seldom ve have complete files farther back three or four months. The only its of articles which have appeared ook form are those used in the Wave Handbook, which is now out int. We are glad to learn that ike the magazine and we will keep nd your suggestion about servicing es. In the meantime we suggest concentrate on the Serviceman es which are intended to portray day practical faults which are likely ck the beginner.

. (Carlton, Melbourne, Vic.) would to know if the mains cable, if in- d in the cable from power supply t, will induce hum in the adjacent r and HT leads. He also asks if ould be possible to use an EF50 an X61M valve in the latest S/W erter.

It is not likely, G.B., that the s lead would cause trouble in these mstances. The heater leads carry anyway, and the HT supply is ly bypassed at many points within set, so that it would be quite ali to use 6-core cable for this pur- The two different valves in the erter are not likely to cause any r with the circuit values specified, ided the larger sockets could be mmodated. The converter could be if need be, on a somewhat larger lis.

. (Hamilton, Brisbane, Q) asks us xplain the advantages and disadvan- of 110 or 240 volts AC for domestic oses, and which ultimately is the satisfactory.

From the point of view of the user, there is no great difference, as equipment can be made to work as efficiently on either voltage. The lower voltage in the USA was chosen on the basis of safety. However, for a given power load, the current drawn from the supply is double and the problems of distribution without high resistance losses are greater. In fact, where high current loads are to be supplied in USA, it is usual to bring in two phases or leads to give 220 volts.

W.B. (Daylesford, Vic.) asks if we can advise him on a book covering television from A to Z, and if we think that transistors will replace valves.

A. As we have said before in these columns, the position on text books varies from week to week and new books are all the time coming forward. Particularly at this time with the increased attention to televison, some excellent books should be coming forward and we suggest you contact your bookseller. However, R. and H. did run a series of articles on the complete fundamentals of TV and these would certainly assist you in your new hobby. Transistors will certainly play a big part in the future of radio but it is far too early to predict exactly what their ultimate limitations will be.

D.A.J. (Wagga Wagga, NSW) wants a circuit featuring all-band coverage, push-pull output, and many other features, plus combined AM and FM channels.

A. Sorry, D.A.J., but have never described anything as ambitious as this. The best we can offer is several large set designs featuring most of your requirements in the AM channels but we have nothing along the lines of combined AM-FM sets. In fact, such designs are extremely complicated and could appeal to only a limited number of readers. This is accentuated by the limited FM channels available, those which are operating being easily catered for by the tuners similar to that recently described. Some of the circuits which may prove helpful are the Multi-Band Seven (August, 1953), The 1950 Radiogram (January, 1950), the 1947 Senior Radiogram (June, 1947), &c. Copies of these circuits are available through the postal service.

M.H. (Fulham, Vic.) writes to tell us about the success he has had with the All Wave Battery Two. His log includes hams from all States of Australia, New Zealand and the US. In addition, many overseas commercial and Government stations. He also asks if we can recommand a good battery-operated valve suitable for super-regeneration at 144 Mcs.

A. Many thanks for your letter, M.H., and we are very glad to learn of the excellent results you have obtained from the little set. Sets of this type are first-class material for the beginner and their performance, when correctly built and adjusted, can be really startling. The best valve for your requirements would appear to be the 958A Acorn type. You may be able to obtain one of them through disposals channels.

D.A. (St. Kilda, Victoria) writes to suggest that we publish some articles on radio control for models and wants to know if we are planning anything along these lines in the near future.

A. We cannot make any definite promises at the moment, D.A., but we have been considering something along these lines for some time. However, we want to be quite sure that anything we describe will be suitable for the average reader and that all the components required are readily available. Assuming that we can overcome all these difficulties, we may be able to follow your suggestion.

S.S. (Parramatta) says he has been experimenting with the valves and sockets in his commercial receiver, cross-connecting it with other small sets he has built.

A. We can only suggest that you be wary about such "experiments", because there is a grave risk of damaging your set, unless you know what you are up to. The longer leads which are introduced by such connections can easily cause instability so it is not surprising that you heard a few "whistles". You would be well advised to leave your commercial set as is and confine your activities to the small sets, following approved circuit designs. You have not mentioned the valve types used in the set ,so we cannot advise as to whether any of them would be useful as detectors. The number of pins on the base means very little—you would have to state the type numbers.

Q: H.W.U. (Alectown, Parkes, NSW) inquires about the color coding of small fixed condensers which are coded with several dots, and resistors coded with colored rings.

A: The basic system for resistors having colored bands around them is no different from the older system of body, end, dot, color coding. The value of the various colors remains the same and the colors are read from left to right when the resistor is placed so that that colors are nearest to the left hand side. For capacitors, an arrow generally indicates the direction of reading, while the numbers refer to pF or mmfd. For further information on this we would refer you to Radio Designers' Handbook, Fourth Edition, page 1335, which you can probably obtain from your local technical library.

N.S. (Cooroy, Qld) would like to have details of boats of various sizes.

A.: We are afraid, N.S., this magazine does not deal with the building of boats, so we cannot give you details of the craft you have in mind. A letter to one of the magazines dealing with marine craft or one of the sailing clubs would probably bring more results.

S.E.W. (Dareton, NSW) sends us a circuit of a tape recorder, which he proposes to build. He would like to know, if the circuit is workable, before he proceeds with the construction.

A.: The circuit, as it stands, appears to be very similar to the No. 2 Tape Record-

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required ust be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided he information can be drawn from general knowledge. UNDER NO CIRCUM-TANCES, however, can we undertake to answer problems involving special esearch, modification to commercial equipment or the preparation of special ircuits.

Whatever the subject matter, we must work on the principle that a letter s too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in he columns of the magazine and presented in such a way as to be of interest to ther readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cut-outs in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

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er published in this magazine some ago. As such, there is little doubt it would work although there are minor points to be mentioned as re component values and tone compens The monitor speaker volume co should be much smaller in value, o order of 75 ohms, as this is a low pedance circuit. A .5 meg, pot. a point would not be practicable a Also, in re-designing the circuit you omitted the tone compensation ci which is desirable for correct bal We doubt if the tone control substi would be effective enough for this pose. On the whole, we cannot see point in using the modified circui the original has been tried out and are no difficulties about it. There w be no saving on cost of components while speaking of. As regards m phones connected in parallel, there w be no difficulty in doing this pro they were identical units. However, would seem to be little point in the id

H.R.B. (Broken Hill, NSW) inquire we have a copy of the January 1954 containing details of the No. 6 master amplifier.

A.: Unfortunately, HRB, copies of issue have been sold out, and are no lo available. However, circuit diagr part lists and photos for this ampl are obtainable from this office at a of 2/-.

U.G. (Melbourne, Vic.) sends in questions for our column, "Here's Answer, Tom."

A.: Thank you U.G. for your kind w We have filed your questions for fu reference and you will find the ans to them in a forthcoming issue.

T.H. (Earlwood, NSW) would like know what the difference is betwee absorption wavemeter and a grid oscillator. He is also interested in meaning of different classes of amplif such as A, AB1 and B.

A.: The essential difference betw the two instruments is in the way indicate the frequency of a tuned cir The absorption wavemeter, as its n implies, absorbs some energy from tuned circuit, which has to be in op tion. It uses this energy to mov meter or light a small lamp, as the strument is tuned through the reson frequency of the active circuit. The dip oscillator generates its own po When the instrument is brought nea coil, a certain amount of this power be absorbed by the coil, when tuned the frequency of the oscillator. A me measuring the grid current of oscillator, indicates the strength oscillation. When the instrument brought near a tuned circuit, power absorbed and the meter deflection is duced. The pointer dips, hence the na

Classes of operation of amplifiers re to the operating conditions of the vali In Class A the bias is fixed at a po half way between zero bias and cut The signal driving the valve swings tween these extremes, without actu driving the grid positive, or beyond c off. Plate current flows during whole of the incoming signal cycle. Class B the valve is biased near cut so that the incoming signal drives grid positive in one direction and yond the cutoff in the other. Pl current flows only during the time grid is above the cutoff point. Cl AB1 indicates a condition, where valve is driven beyond the cutoff po during part of the cycle, but the grid not driven positive. This condit is achieved by setting the bias to a st able level. Class AB2 is similar to cl B, in that the grid is driven positi but the plate current cutoff occurs nea the negative peak of the signal. Aga this is achieved by applying suita bias to the valve.

H.E.P. (Toowoomba, Qld) inquires abo electronic flash units of 100 Joule o put or more.

A.: Electronic Flash Units descrit in this magazine could be adapted to g 100 Joules output by using slightly lar capacitance values than specified. Th are four different circuits available, Hi voltage units, and low voltage units dry battery, mains, or vibrator operati With the first three, the larger capa tance could be accommodated within t case specified. With the fourth, ho ever, it would be necessary to enlar the case somewhat. Reprints of circu &c. are available from this office at per three, as also are chassis blueprir at 5/- each.

st Month's Solution

T	E	N	T	I	O	M	E	T	E	R				
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THE ELECTRON ICROSCOPE AT WORK

Continued from Page 11.)

intain a vacuum in the electron The vacuum is as necessary to ibe as that in a radio valve. focus the beam on the screen, the current through the wind- of the electro-magnets, or the voltage, is varied. the case of APM's microscope, ocusing magnets are at a per- nt strength, and the high volt- s varied to produce the effect cusing. special power supply is used, i is regulated to make sure the ge does not vary more than a small amount, through fluctua- n the power supply. e APM microscope is one of in Australia. It is the only one tely owned in the Common- h. s being used in the development w types of paper, and to find r ways to make existing types.

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nong thousands of spectacular vements, the electron micro- has made possible the study of ins, has helped research into er, encephalitis and myxomatosis, greatly advanced knowledge of ial fibres like silk and wool, syn- c fibres like nylon and terelene. has revealed many formerly un- vn facts about the structure of il alloys, and metal particles, substances as rubber and latex plastics and increased our know- e of dusts and smokes.

ie pulp and paper industry has to with both the macromolecular tance, cellulose, and finely divid- particulate substances in fillers, ients, sizes and addition agents. ie dimensions, condition and dis- ition of all these things play an ortant role in determining the perties of the final product. any details of fibre surface con- ns are beyond the range of the t microscope, but are revealed in il by the electron microscope. ut paper and board do not consist lusively of cellulosic fibres. Per- s the longest-used of the non- ous ingredients is resin size to trol its wettability. For proper ciency, it must be distributed to cover as many of the fibres as possible.

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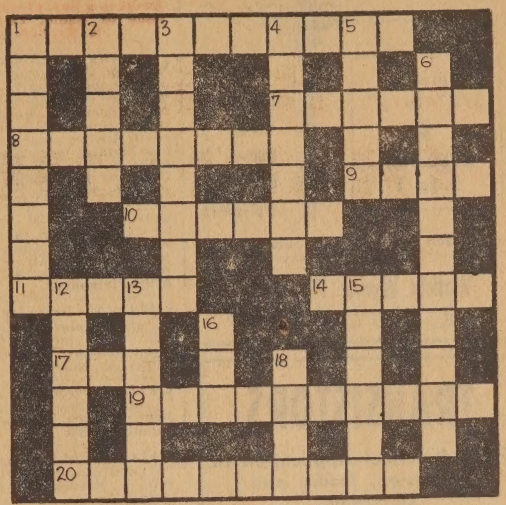

ACROSS

1. Adjusts frequency range (2 words)
7. Used for joining metals
8. Variable resistor
9. Tuning mechanism
10. Type of crystal
11. Observes
14. Left over
17. Beverage
19. Unit of frequency (pl.)
20. Continental radio brand name

DOWN

1. Electronic instrument played by hand capacity
2. Unit of attenuation
3. Type of band-pass filter (pl.)
4. Checking
5. Lubricated
6. Non-glass radio tubes (2 words)
12. Final signal
13. Wire coating
15. Surround
16. Terminal tag
18. Action of a beam of light in TV

Solution and further crossword next month

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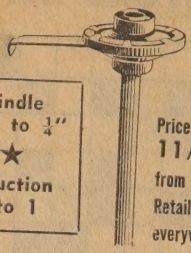

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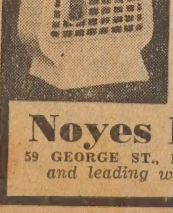

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